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ABSTRACT

A 3-month evaluation design effort developed a strategy and implementation plan for a policy level evaluation of the Educational Satellite Communications Demonstration (ESCD). The final report of the effort covers: (1) development of the evaluation strategy and plan; (2) data collection and analysis; (3) measurement of the impact of satellite TV on the way educational institutions are perceived; (4) measurement of the impact of satellite TV on educational institutions and behavior toward them; (5) calibration of use that is made of satellite TV. The report also contains a study of the decisions and events that led to ESCD, an economic analysis of satellite based educational services, a technical and economical evaluation of the ATS-F ETV experiment, and a description of project management and organization. (WCM/JY)

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DESIGN FOR AN ANALYSIS AND ASSESSMENT OF THE EDUCATION SATELLITE COMMUNICATIONS DEMONSTRATION:

FINAL REPORT

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Prepared for:

National Institute of Education
1832 M Street, N.W.
Marsh Building, Room 721c
Washington, D.C. 20208

By:

Practical Concepts Incorporated
1030 Fifteenth Street, N.W.
Suite 940
Washington, D.C. 20005

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PREFACE

This report is submitted to the National Institute of Education by Practical Concepts Incorporated in completion of the contractural requirements under Contract No. NIE-C-74-0047. This report presents the results of a three-month evaluation design effort undertaken by PCI to develop a strategy and implementation plan for a policy level evaluation of the Educational Satellite Communications Demonstration (ESCD).

This report is presented in four primary parts:

1. Executive Summary;
2. Development of the Evaluation Strategy and Plan;
3. Data Collection and Analysis;
4. Project Organization and Management.

Part 5 of this document are appendices including the following:

A. Approaches to ESCD which We Considered but Discarded;
B. Organizational Image Changes Resulting from Satellites;
C. List of PTA Groups in Alaska/Rocky Mountains;
D. Cultural Indicators: The Social Reality of Television Drama;
E. Representative Secondary Hypotheses;
F. Brochures: ECON, Incorporated; Education Turnkey Systems;
G. Vermont/New Hampshire Interactive Television Hypotheses to be Tested in ESCD;
H. Roger Coates Memorandum Regarding PCI and the Indian ATS-F Experiment;
I. Optional Intensive Analysis of Four Alaskan Villages.

Costs for implementing this evaluation are submitted under separate cover.

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EXECUTIVE SUMMARY

A. INTRODUCTION

In June of this year, the National Aeronautics and Space Administration will attempt to put into orbit a multi-component experimental satellite called the Applied Technical Satellite-F (ATS-F). One of the many services the satellite will provide on a demonstration basis will be the Educational Satellite Communications Demonstration, in which programs are broadcast to isolated schools and communities in Rocky Mountain states, the Appalachia region, and Alaska. The federal government has awarded three grantees access to ESCD:

1. The Federation of Rocky Mountain States, Inc.,
2. The Appalachian Regional Commission,
3. The State of Alaska's Office of Telecommunications.

The grants include funds for ground installations to receive and send satellite-relayed television signals, and for television programming. ESCD is intended to be both a demonstration of uses to which satellite television might be put by the educational community, and a test of how and whether such a system is useful.

To provide information for forming satellite television policy on the basis of the demonstration, the grantees will gather and analyze information about their own operations. Grantee evaluators are concentrating their efforts on assessing the impact of ESCD on the student/audience. The focus of the national evaluation described here is the impact of ESCD on educational organizations' and institutions' interrelationships and procedures.

This report presents the recommendations derived from a three-month study performed by Practical Concepts Incorporated to define a national level evaluation that will supplement rather than compete with evaluation activities already undertaken by the regional grantees. As the regional grantees are both the proper agents for evaluating educational impact in terms of learning effect per se, and are in fact adequately performing that function, the national evaluation recommended in this report focuses on:

1. Whether and how the ESCD causes educational organizations and institutions to change their perceptions of themselves,
2. Whether and how the ESCD causes educational organizations and institutions to change their basic procedures,
3. Whether and how the ESCD causes interrelationships among institutions to change.

The purposes of undertaking the above are:

1. To learn more about this country's education system,
2. To recommend ways to remediate systemic deficiencies in education systems,
3. To forecast the long-term role for satellite communication as an adjunct to education systems.

B. DEVELOPMENT OF THE EVALUATION STRATEGY AND PLAN

This section highlights PCI's study conclusions to clarify the evaluation strategy. This material consists of:

1. Evaluative Focus;
2. Impact of ESCD on the Educational System;
3. ESCD as a Demonstration;
4. Observations on Satellite Communications;
5. Conclusions Regarding the Economics of the ESCD.

1. Evaluative Focus

- Extensive experimentation in ways of improving education has yielded no conclusive evidence on how to make such improvements.
- Where improved effectiveness of education has been realized, it seems to be a function of better management, rather than better educational techniques per se.
- It follows that the impediment to improving educational effectiveness must be inherent in the way educational institutions are organized and interrelated. That is, it is the educational "system" itself -- the way organizations behave and inter-relate -- that is inadvertently defeating our attempts to improve the the educational process.

2. Impact of ESCD on the Educational System

The one thing that ESCD will undoubtedly do is circumvent conventional information channels and, to a lesser extent, circumvent jurisdictional issues for both the telecommunications and the educational communities.

Therefore, ESCD will almost undoubtedly change the interrelationships among the organizations involved in the experiment and, to a lesser extent, the relationships between participating organizations and those having jurisdictional authority over telecommunications and education.

Hence, ESCD affects the factors that should be of primary interest to educational researchers -- organizational functions, interrelationships, and inertia.

Therefore, ESCD, by in that it directly modifies the organizational relationships, is a uniquely valuable experiment in educational improvement.

3. Considering ESCD as a Demonstration

- The job of administrators of demonstrations of new technology is not only to introduce innovation, but to allow and stimulate people and institutions to innovate. (We interpret "innovation" to mean problem-oriented adaptiveness -- the ability to address a problem with a minimum of a priori assumptions.)

- Whether the uses to which satellite TV is put in the demonstration result in learning is interesting, and may be a measure of whether grantees have made innovative use of satellite TV technology. But it is not of central importance. If there is learning, it should be no surprise. And if there is no learning, it does not mean that future applications would also result in no learning. We already know that television can be an effective teacher, and as far as the class-room learning experience is concerned, there is no necessary difference between satellite TV and TV in general.

- One question which ESCD should answer is whether and how NIE should implement demonstrations as a method for causing school systems to experiment with curricula and procedures. Grantee activities, including regional evaluation efforts, are an important facet of the experimentation. For a central evaluator to remediate data gathering shortfalls, therefore, would be to obscure the grantee self-evaluation element of the demonstration. Nevertheless, some central coordination and storage of data is required to:

  a. Facilitate already desired exchange of data among regional evaluators,

  b. Maintain comparability of data in crucial areas, and

  c. Monitor the quality of the data in terms of the objectives of ESCD.

4. Observations on Satellite Communications

- Satellite communication cost is independent of communication distance. It costs the same to transmit from New York to San Francisco as from Manhattan to Staten Island, provided you use a satellite link; hence, the AT & T decision to use satellite for all long-line communications of over 1200 miles. This feature of satellite communications is of obvious importance in Alaska where long distance communications are a way of life, but of less obvious importance elsewhere in the United States.

- A feature of satellite communications which is of potential importance virtually everywhere is that it allows amortizing the cost of centralized programming and broadcasting over very large populations. Ground station technology becomes, therefore, the pacing item, because ground stations can only be amortized over relatively small populations.

A crucial issue is how to trade off the above features of satellite communications against local (community) needs to find an optimum balance.

5. Conclusions Regarding the Economics of the ESCD

- A purpose of demonstrations of new technology is to speed the return on investments in research. Or, put another way: a purpose of demonstrations of new technology is to bridge the gap and shorten the time between research and unsubsidized operations. For economic analysis, therefore, an appropriate criterion against which to measure satellite TV is whether there are sufficient potential investors to support it without federal subsidy. Satellite TV becomes economically attractive to an investor when, everything else being equal, a service is cheaper to deliver per viewer hour by satellite than by other means. Potential investors are: the satellite and broadcasting industries producers of television programs and of educational materials, and educational institutions.

- Another purpose of demonstrations is to find out whether a new technology has sufficient social value to warrant subsidy on an operational basis. For example: the government might subsidize satellite TV operations if it were proven that it had a beneficial impact on education systems.

- Federal subsidy is not an all or nothing proposition. Alternatives include:

  a. Near term: both satellite channel and programming federally subsidized.

  b. Medium term: either satellite channel or programming subsidized, but not both.

  c. Long term: both satellite channel and programming supported non-federally.

C. FOCUS OF THE EVALUATION

Our conclusions regarding the probable affects and relative importance of the ESCD in its ability to perturb the educational system has led us to focus the evaluation in ways described in the following:

1. Our measures of the impact of satellite TV on the educational community will concentrate on such questions as:

   a. Does satellite TV change local school teachers' perceived power in relation to the traditional educational establishment such as boards of education and universities? (For a discussion of how an institution's image affects its performance, see Appendix A.)

b. During and following the demonstration do local school teachers make demands of the traditional educational establishment which are similar to demands they can make of the ESCD grantee?

c. Does satellite TV increase the prestige of participating organizations and personnel in the eyes of local and educational communities?

d. Does satellite TV participation stimulate innovative approaches to solving educational problems on the part of the grantee institutions, and on the part of local schools?

e. Does satellite TV cause telecommunications and educational institutions to compete with it, and consequently improve efficiency or find innovative solutions to problems? And do the competitors change educational institutions the way we hypothesize that satellite communications will?

2. We will study whether and how federal decision and funding strategies have allowed and stimulated people and institutions to find innovative uses for satellite TV.

A working hypothesis is: To the extent that we subsidize the use of technology, the net effect on the organization's internal operations will be reduced. An institution that cannot add staff, or otherwise "insulate" itself when faced with the technology, must change something if it is going to use that technology. On the other hand, an organization that is given funds to "adapt to" that technology need not in fact adapt. It can instead create a buffer organization between it and the technology, so that we have added to the organization but not changed anything that pre-existed.

3. We will consolidate and synthesize conventional measurements of learning done by local evaluators, but will do none ourselves.

4. We will loan one PCI staff member to each of the three grantees on a half-time basis. Depending on work necessary, and the obtrusiveness of the arrangement, PCI presence during the demonstration might be scaled down to 1/3 time.

5. In our attempts to predict the future demand for satellite TV we will pay special attention to:

   a. groups of people who share common educational needs, but do not happen to live together in the same region (occupational groups, people suffering from similar handicaps, etc.);

   b. the future prices of ground installations, and the possibility that direct reception of satellite-relayed materials may one day be available at popular prices. We will try to estimate if it will happen, when it might happen, and how it might happen. And we will try to predict its social benefits and costs.

6. In our demand analysis we will answer questions such as the following:

   a. How much can we expect the educational community to contribute to regional communications based upon "breakeven" costs as compared with alternatives?

   b. How much can we expect the satellite and broadcasting industries to contribute to regional communications based upon "breakeven" costs as compared to alternatives?

   c. How much can we expect producers of television programs and educational materials to contribute to regional communications based upon "breakeven" costs as compared to alternatives?

d. Based on perceived social value, how much and for how long and under what conditions can we expect federal subsidy of satellite TV?

D. QUESTIONS TO BE ANSWERED BY THE EVALUATION

The value of an evaluation can be measured only in terms of the guaranteed information product. Hence, we present in Table 1 a list of the specific questions that we will answer for evaluation, inventorying those questions in terms of three basic types of users:

1. NIE qua NIE
2. The general educational community
3. Telecommunications policy makers

And the several intersections or issues of mutual interest to those communities:

4. NIE and the educational community
5. NIE and telecommunications policy makers
6. The educational community and telecommunications policy makers
7. The mutual interests of NIE, the educational community and telecommunications policy makers.

We add to the above one final "user" posing a question to be answered regarding the implications of this demonstration for federal R & D strategies.

TABLE I-1

QUESTIONS TO BE ANSWERED BY THE EVALUATION

TYPE OF USER	QUESTIONS TO BE ANSWERED BY THE EVALUATION
NIE qua NIE -- the demonstration and educational research.	• Was ESCD payoff in terms of research results attractive enough to warrant comparable types of investment (i.e., in comparable demonstrations)? • Did people learn better as a result of the experiments undertaken during the ESCD? • Can NIE intervention beneficially affect the organizations involved in and/or impeding educational progress, e.g., • Organizational attitudes: Do organizations within the "educational system" perceive themselves as being "more responsive"? • Innovation or result-oriented change: Are changes in programming & procedures innovation? • Long-term education impact: Over the long term, do learners served by the "more responsive" organizations learn more than learners served by less responsive organizations?
Evaluation results of direct interest to the "educational community."	• How much money is it feasible to invest in development of programs for general use throughout a given rural region? (Based on the ability to amortize the cost of programs over an extensive audience by using regional communications capability.) • Has the ESCD inspired private sector (or non-federal) investment in related or competitive educational technology?

TYPE OF USER	QUESTIONS TO BE ANSWERED BY THE EVALUATION
Evaluation results of direct interest to the "educational community. (Continued)	• For a satellite comparable to the ability of the ATS-F, what investment would be justified to achieve breakeven based upon the difference between satellite and current methods of dissemination?
Information for those formulating DHEW telecommunications policy.	• How much can we expect the educational community to contribute to regional communications, based upon "breakeven" costs as compared to alternatives? • Are there specifications for the communications capability required by the educational community, such that educational demand can be aggregated with other HEW interests (i.e., other health and social service requirements) so that we can talk about an HEW communications network as an alternative to an educational communications network. • On balance, do the advantages of regional communications appear to offset their potential disadvantages, particularly with regard to the risk of dysfunctional impact on communities?
The interface between NIE and the "educational comminity."	• What are the strengths and limitations of using such grantee institutions as FRMS and ARC? • What is the value of Federal demonstrations of this type as a mechanism for stimulating a more result-oriented orientation within and among educational institutions? (Value in this sense will be both as perceived by the organizations involved and as actually measured by PCI in terms of constructive change effected in the demonstration.) • Has the ESCD inspired private sector (or non-federal) investment in related or competitive communication technology for use by educators?

TYPE OF USER	QUESTIONS TO BE ANSWERED BY THE EVALUATION
NIE and telecommunications policy makers.	• Are satellite communications to be preferred to alternative means of achieving the same functional capability -- (in terms of glamour affect, ability to circumvent institutional or jurisdictional constraints, etc.)? • Would the above long-term effects benefit operational as opposed to demonstration systems? If so, to what extent? • What is there in this demonstration suggesting that NIE should provide additional input to help formulate policy and strategies of telecommunications? • What information will this demonstration be generating that should be of value to experimenters and policy makers, both U.S. and others, involved in the later communications experiments, e.g., CTS and ATS-F in India? • Has the ESCD stimulated investment in private sector (or non-federal) telecommunications technology? • What type of interaction between telecommunications policy makers and NIE would have increased the value of the ESCD?
The intersection between the educational community and telecommunication policy makers.	• What is a preferred time cycle for creating a regional or national telecommunications capability, to optimize timing of educational investment that would amortize the cost of such operations? • What total expenditure is reasonable to expect the educational community to make in purchase of the communications capability per se?
	• Would educational utilization of operational satellites have demonstration value of sufficient importance to impact secondary investments?

TYPE OF USER	QUESTIONS TO BE ANSWERED BY THE EVALUATION
The intersection between the educational community and telecommunication policy makers. (Continued)	• Would the value of such secondary effect warrant consideration of subsidy based on an ability to accelerate telecommunications technology utilization?
The interface common to NIE, the educational community, and telecommunications policy makers.	• Is it plausible that national/regional telecommunications technology can cause the other educational technologies (e.g. programmed instruction, etc.) to coalesce into a single integrated and high-technology approach to education -- deinstitutionalizing the schools and providing a more personalized learner-oriented educational service? • If the answer to the above question is yes, are there steps HEW can take to accelerate or impede that effect? • Specifically, has Federal involvement in the ESCD accelerated or impeded progress in educational utilization of technology based upon its stimulation or inhibition of innovative investment?
Implications for Federal research and development strategies	• Whether and how Federal research and development investments can create technology that will deliberately compete with institutions and institutionalized ways of doing business, to return us to Schumpater's model of "self-destructive capitalism."

The questions posed in Table 1 provide a clear intersection between our strategy and our data analysis plan. Table 1 can be considered filling in the face value of a set of checks; the burden of the analysis plan is to demonstrate that we will satisfactorily redeem those checks.

E. DATA COLLECTION AND ANALYSIS

Answers to the questions in the previous section will primarily be the product of the five data collection and analysis tasks sumarized below:

Data Area #1:	Impact of satellite TV on educational institutions.
Measured by:	Records that are either collected as a matter of course by local institutions or by local ESCD evaluators.
Data Area #2:	Impact of satellite TV on how educational institutions and technology are perceived (includes demand analysis).
Measured by:	Questionnaires and a procedure we are calling linguistic analysis.
Data Area #3:	The use that is made of satellite TV.
Measured by:	Content analysis which is an objective, reliable, computer-aided method for characterizing and calibrating messages transmitted by the media.
Data Area #4:	The events and decisions that led to ESCD.
Measured by:	Systematic analysis of documents.
Data Area #5:	Satellite TV economics.
Measured by:	Synthesis of local evaluator data collection, plus interviews, questionnaires and record review where necessary.

F. MANAGEMENT APPROACH

PCI's management approach supplements a multi-disciplinary project team with a consortium to include special skills and perspectives:

Dr. George Gerbner	- Dean of the Annenberg School of Communications, University of Pennsylvania -- who will be responsible for the content analysis;
Mr. Charles Blaschke	- and his firm Education Turnkey Systems -- providing further insight into both federal and local school perspectives;
Mr. Bernie Miller	- and Econ, Inc. -- providing individual and corporate expertise in engineering and economics of satellite communications.

The project manager for this proposed activity will be Mr. Albert Feiner, formerly Director of Lister Hill National Center for Biomedical Communications, National Library of Medicine and with extensive experience in communications technology in its applications to social services.

Other senior-level PCI staff assisting Mr. Feiner in this activity include:

Roger Popper, PhD.	- who will direct measurement and analytical activities;

Mr. Leon Rosenberg - a skilled evaluator and organizational analyst who will evaluate ESCD with an eye to the implications for NIE and Federal R & D strategies;

Lawrence Posner, PhD. - an economist with special credentials in the cost-effectiveness of education who will be responsible for the success of our economic and cost analysis.

Ms. Molly Hageboeck - a skilled evaluator and manager whose credentials include managing PCI's evaluation and management support of the Interact Project (which links seven rural medical facilities by interactive television).

In addition to this core team of skilled and practiced evaluators, we also propose to involve in our deliberations and project reviews a "gatepost group" -- individuals deliberately selected to represent a spectrum of opinions not normally represented in educational counsels. Such gatepost opinions range from those who think that satellite TV is a profound evil that will homogenize and destroy us and all individual initiative, to those who feel that this will be the coalescing technology that finally allows us to take advantage of the supplementary technologies to provide true innovation in education.

G. INFORMATION DISSEMINATION

To ensure effective dissemination of the information generated by this evaluation, we will supplement the five final reports with special interim reports (for example, one describing the potential transferability of the content linguistic analysis technique to other educational problems). More important in terms of NIE's role as a disseminator of research knowledge, we will host semi-annual seminars at which we will present the preliminary evaluation results to a colloquium of educators and evaluators (to be selected in cooperation with NIE).

SECTION II

DEVELOPMENT OF THE EVALUATION STRATEGY AND PLAN

A. INTRODUCTION

1. General

When Practical Concepts Incorporated undertook this study, we were skeptical both as to the value of the demonstration (a) in predicting the value and market for operational systems, and (b) as an experiment *per se*. We have pursued many blind alleys, and spent many exhausting hours in analyses that led nowhere, developed plausible designs for national samples, for testing education impact, etc. We examined and pursued all plausible alternatives to evaluating this activity, and discarded most of them as being inappropriate. (See Appendix A for a discussion of these discarded alternatives.)

However, what has emerged from the ashes of our intensive and partially misdirected efforts, has been a strategy for effecting an evaluation that will:

1. Provide important information about the demand for the types of services and products that the educational satellite broadcasts can provide, and

2. Use this demonstration as a test bed for what we perceive to be the most fundamental problem facing the educational community -- the need to make educational institutions more responsive, more innovative, and better suited to educational results.

We have then, dramatically reversed our initial skepticism, which suggested that the plausible level of activity for evaluating the ESCD would be nil, to a position whereby we think this evaluation rates a high priority in terms of research value and can responsibly address issues of operational value and economics.

2. About the Technology

The terminals of the system are characterized as receive, intensive, and comprehensive. The receive terminal can only receive TV signal input; the intensive terminal can receive a TV signal input and can also transmit and receive a voice signal; the comprehensive terminal can receive and transmit a TV signal and also transmit and receive a voice signal.

The classroom receiver/monitor receives a synchronized aural visual signal. Visual quality for a color display in a viewing area is defined in terms of the following parameters:

1. Picture resolution
2. Picture chromaticity
3. Signal linearity and synchronization
4. Picture brightness
5. Background illumination

Of these parameters, 1, 2, and 3 are dependent on the content and quality of the received signal and 4 and 5 are controllable within the classroom. Only 1, 2, and 3 will be discussed in this technical discussion.

A voice signal accompanying a video signal is generally accepted to be less subject to degradations than the video signal itself, so that the technical discussion will concentrate on the video signal possible variations. Voice and data signals employed for interactive purposes will be discussed separately.

Two communication systems will be discussed. The first system is that currently designed and designated as ATS-F. The second system will be called an operational system which means that it is a system designed for educational networking in the future. Since the exact form of this operational system cannot be stated with a high degree of confidence, the discussion will concentrate on the differences in design and operating characteristics that might be expected in an operational system.

a. The Experimental Education System of ATS-F

ATS-F will conduct multiple experimental missions from space. One of these experiments is the Educational Television Experiment (ETV). The ATS-F will be the first NASA spacecraft to be three-axis stabilized in synchronous orbit. It will be used to demonstrate that a 30-foot parabolic antenna can be deployed in space. It will be used to demonstrate a design capability for fine pointing accuracy, 0.1°, a design capability for precision slewing of an antenna beam at 17.5° in 30 minutes and a capability for precision tracking of a ground point since the orbital inclination of ATS-F will be 1.8° and not 0°. All of these cited experimental objectives may influence the ETV signal reception.

The ETV earth receiving antenna with its 7.2 db/°K figure of merit is newly designed, 3-meter diameter, four petalled fiberglass plastic structure mounted on a pedestal. It is an experimental design with its operating feasibility established in a measurements program. The earth receiving equipment preamplifier and receiver have been very simply designed to receive two color TV channels at minimum cost. Because of the simple design, cable lengths from antenna to receiver and from receiver to TV display must be controlled to 100' and 300' respectively if no signal loss is to occur. Each earth receiver is equipped with a signal meter which can be visually observed and used to orient the earth receiver antenna to maximize the received signal. In addition, provision is made on board the spacecraft for reorientation of the spacecraft antenna boresight or pointing to move the antenna fields of view to improve performance.

The operating carrier frequencies for each TV channel are at 2.5692 GHz and 2.670 GHz selected by NASA to simplify communication system design. These frequencies are in the newly allocated 2.5 GHz band only recently approved for satellite down links. As consequence, the precise nature of the atmospheric interaction with these carrier frequencies is not known although it is estimated to be extremely small. Each earth receiver can be switched between TV channels, manually.

The ETV system radio frequency modulation for the two TV channels, two aural channels, four sound channels and telephone channels is frequency modulation (FM). Since the normal TV receiver is designed for reception of Amplitude Modulation (AM) video signals, each receiving system must employ a conversion from FM to AM.

The ETV downlink signal is left circularly polarized and the atmosphere could modify this polarization and produce losses at the receiving antenna.

Each of these general system characteristics could result in signal reception deviations from the nominal design or could produce geographic and/or time signal variations, at the system receiving terminal.

ETV specific system structures: Each regional educational experiment is specifically structured.

The ARC experiment has different origins for pretaped audio and live video and aural programming but it is not expected that any signal variations should result from this. The satellite downlink employs two fixed beams (north and south) and transmits programming directly to 10 receive and 5 intensive terminals. The intensive terminals can employ a full duplex VHF audio and data link via ATS-3 among them and with the University of Kentucky where the experimentor is located.

The FRMS experiment has a single programming source but must use two individual pointings of a pair of beams to produce the required coverage. This experiment transmits programming to 44 receive only terminals and 24 intensive terminals. Audio and data can be sent via ATS-3 from and among the 24 intensive terminals in a half duplex mode so that data and call/admin communications are entirely separated.

The Alaska experiment permits programming origination at two comprehensive terminals in Alaska at Fairbanks and Galena or alternatively in Colorado. From Colorado via ATS-F the programming can be either recorded at Fairbanks or sent directly by an undefined terrestial interconnect to 15 intensive earth terminals. The 15 intensive earth terminals have a simplex link via ATS-1 at VHF for audio and data to the comprehensive earth terminals. The undefined terrestial interconnect may imply unknown signals modification for certain programming inputs. Each application transmits the downgoing programming simultaneously over an Earth Viewing Horn (EVH) for monitoring of the program material.

The Nominal system design parameters: The system spacecraft gain, rf power, the earth terminal antenna, preamplifier and receiver have been selected and designed to provide a TASO grade 1 signal at the TV receiver. This requires a signal-to-noise ratio, S/N, or 43 db, and provides the best subjective TV picture for all but 1% of the population under normal viewing conditions. Again as a design goal it is not expected that the value of S/N will be less than that of TASO 2, for a fine picture, at any receiving site.

Voice quality throughout is defined by an S/N of 42 or 43 dbs, a subjective grade between good and excellent.

Local influences on signal quality: "Noise" or interference can be generated locally to produce picture and sound degradation which must be handled as a local adjustment problem for each site where it occurs. These local forms of noise are described as "ghosts" or "snow" often correctible by antenna adjustment, or radio frequency interference (RFI) resulting from locally generated rf signals in the system operating bandwidths.

In addition, since the system carrier frequencies lie in the bandwidth of the ground operating instructional television fixed service (ITFS) operating frequencies, any ITFS transmitter may interfere with reception unless the separation or coordination distances have been properly specified.

The standardized classroom receiver is an RCA LYCEUM 25" all solid-state device XL100 especially designed as an Instructional Receiver/Monitor designated JT 970-W. The set is factory-aligned to specifications incorporating both technical and viewer subjective factors. Subsequent to installation the set is automatically controlled for performance although the automatic feature can be overridden and manually adjusted according to viewer preferences.

Programming hours expected for the system: The programming hours are tentatively as follows:

- July - mid-August 1974
  - 4 hours/week pretaped new TV production
  - 1 hour/week audio based programmed instruction
- September 1974 - May 1975
  - 2 hours/week live video with interactive audio
- A minimum of 2 hours/week of computer-managed instruction

- 6-week seminar from the University of Kentucky to ARC beginning 2 July 1974.

This technical review of the Educational Experiment of ATS-F has indicated that there are potentially many sources of possible degradation of the signal-to-noise ratio which identifies the technical/subjective quality of the program presentation in the classroom.

b. The Educational Operational System

The consensus of the experts in satellite educational programming networking, such as Morgan and Singh at Washington University, St. Louis, is that the primary constraint on the development of an educational operating system will be economic and jurisdictional rather than technical. Nevertheless, many system technical choices and decisions will have to be made in designing an operational system, some of which will be made for economic reasons. Unless, however, the end technology, i.e., that used in the classroom is changed from its current operating characteristics, the precise technical methods for delivering the programming material must be compatible with the end technology. This will always require signal conversions to be made appropriately, between the earth receiving antennas and the classroom equipment, as with ATS-F. It is possible that if the cost of transmission is appreciably reduced, then reduced costs in end technology may be sought and totally new concepts of educational programming presentation may emerge. At this time, no essentially new presentation concepts are under development but rather, investigations are being made to define and select combinations of current presentation techniques for "optimum" educational presentation. Thus, for the evaluation of in-classroom educational effectiveness, technical measurements in support of effectiveness quantification will remain essentially unchanged in fundamentals from those developed for ATS-F.

End technology development is moving to solid state wall panel displays with higher resolution potential than currently exists in the every day TV set. It is possible that an operational educational TV system, if it offers a large market for a manufacturer, could result in a TV display specialized for education and classroom presentation. This would require technical educational parameters to be deveoped - in particular, spatial resolution and color resolution, and brightness appropriate to the education environment.

In many educational applications, single frame presentations of various types have been seen as advantageous. Storage media are available for such approaches and are under development for some of the systems being conceived for cable TV.

For an operational system, it appears reasonable to assume that the system design will embody signal processing and signal transmission for real time continuous or consolidated evaluations of the classroom educational interaction, and that evaluation would be centralized at some level, via the satellites in the system. This will require the development of appropriate evaluation observables, by the educators, and the design of an appropriate accessing procedure for the transmissions.

The following technical discussion will be directed to the technical changes that could be incorporated into an operational system design.

Operational system technical discussion: Any future operational system must be designed in such a way as to minimize its interference with other systems operating terrestially and in space in the same frequency band. This requirement and the need for increasing numbers of TV channels to be available will urge educational networks to an operating carrier frequency of 12 GHz. Since this frequency is completely unregulated, the downlink power can be the maximum attainable from the technology. Development is currently under way in the U.S., Japan, and Germany to produce the required 12 GHz technology with some development being devoted to create "cheap and dirty" multi-TV channel receivers and converters for the earth terminals. Concurrent with the trend to 12 GHz employment are investigations to increase and define the localized influences of precipitation (rain, snow, ice) on the received signal amplitude, phase and polarization, to clarify the expected atmospheric influence. The current data is very limited, and perhaps limits the transition to 12 GHz carriers.

TV signals are currently accepted as analog inputs to the process of signal modulation, which is usually FM. Current and future trends are to digitalization of both TV and voice basebands (basic information), to more effectively use the powers and bandwidths available and to reduce transmission errors in the baseband information. If digitalized processing is employed along with multiple accessing of the system, then the most efficient modulation method still remains controversial, as does the best signal modulation for a minimum cost earth station. Digitalized processing and the availability of high speed digital circuitry makes it practical to implement TV signal bandwidth compression or reduction techniques by specializations in signal sampling, combined with some signal storage equipment.

At 2.5GHz, a single antenna beam can carry approximately 4 or 5 TV channels. At 12 GHz the bandwidth in the beam can accomodate about 12 TV channels. With digitalization and the same delivery quality, the number of TV channels could be doubled. Expansion of the number of TV channels can be further achieved by employing dual polarization in the signal which are mutually orthogonal. If dual polarization is needed to achieve the number of TV channels required per receiving site, then the transmission antennas and the earth receiving antennas must effectively isolate the individual polarizations. Atmospheric polarization variations can limit the actual achievable isolation between polarizations. When the problem of antenna alignment is considered, it is not clear whether linear or circular polarization should be chosen for the system operation. The significance of being able to clearly define the number of TV channels required per receiving site in the system [illegible] apparent. Efficient use of available space power, again directed to reduced cost of earth terminals, can result from the development of multiple antenna beams, formed from a singel antenna structure in space. If the beams can be also readily conformed to variations in coverage area required, this will result in power being put only where it is needed and the use of the power will be maximized.

3. Approach to Developing an Evaluation Strategy

Our general methodology for development of an evaluation strategy was to initially separate into simultaneous parallel activities, the issues of:

a. Defining the data that would respond to the important needs of the evaluation, and

b. Selecting measurement strategies and approaches.

This separation was selected so that we would not prematurely compromise the potential utility of the evaluation by a priori determinations that certain data were simply "not feasible" or "not available."

First we completed independent developments of (a) Data and measurement requirements (based on issue analysis) and (b) Measurement approaches based on the real world constraints deemed appropriate in view of the nature of the experiment itself. The total information was synthesized to develop performance requirements and constraints on the evaluation assumptions, specifications and restrictions for our data gathering.

A few words on the two paths of this approach are presented in the following paragraphs:

a. Defining the Data to be Collected

The definition of data to be developed by the study involved a sequence of activities:

1. Defining the issues that must be resolved in order to answer the questions and policy issues of interest;
2. Defining the information that would responsibly resolve those issues and answer those questions;
3. Defining the data from which such information could confidently be derived;
4. Developing preferred and alternative measurement approaches for obtaining such data.

These sequence of events were performed independently down two paths. The first path involved working from the specific questions and broad policy issues outlined in the contract (questions 1 through 5 inclusive). The second branch of the analysis was a synthesis based upon a review of the experiment from the perspective of PCI's experience in comparable programs. By combining these two perspectives, it was felt that we would isolate all truly important and actionable issues that could be addressed by the evaluation.

b. Development of Measurement Strategies and Approaches

This independent branch of the analysis was basically aimed at developing economical alternatives for data gathering. It was clear from the outset that, based on the conditions of the experiment itself, there were some types of data gathering that were simply too costly to consider further.

For example, it would be extremely interesting (and possibly valuable) to have information regarding the direct educational impact of the ESCD broadcasts. However, the costs of obtaining that information -- measured in such terms as (a) Intrusion on the ESCD experimental arrangement, (b) Literal cost of gathering the data, (c) Additional reactive impact of our measurement,etc. -- were very high.

The relative value of educational impact data is also low -- as it is sharply diminished by the probability that no effect would be observed, and by the virtual certainty that grantee institutions would themselves be making measurements of this type. Hence, it was quite early on in the study determined that the cost effectiveness of data regarding educational impact was too low to warrant further consideration.

Hence, as an operational constraint upon our evaluation strategy, we determined that educational impact would either not be gathered by the PCI team, or would be gathered by "piggybacking",relying entirely on the data generated by the grantees. We reserve the possibility, however, that PCI could make recommendations regarding or actually involve itself in follow-up studies performed after the first year of actual experimentation.

Similarly, individual cost effectiveness considerations were made for diverse alternatives to data gathering, ranging from the highly automated direct observation techniques discussed in our original proposal, through the infiltration of teacher organizations by members of PCI staff having a flair for the covert. (We are happy to report that the cost effectiveness of most forms of covert activity eliminated their further consideration quite early in the game.)

The one form of covert activity that might be relatively cost effective in terms of value of information received would be to commission members of the audience (e.g., a participating teacher) to report on his experiences and those of his colleagues. We have discarded this strategy for both ethical and practical reasons -- and also because its relative value is diminished by the probability that we can gain comparable value from overt retrospective analyses.

c. Summary of Conclusions Regarding Measurement Strategy

Coupling our multiple measurement problems with the synthesis of our issue analysis process, our basic measurement strategy was developed as follows:

- Focus of PCI's analytical attention will be upon institutional rather than individual change.
- Content analysis provides a single basic mechanism for analyzing different types of communications (e.g., documents and broadcasts), organizational and cultural as well as individual attitudes, and allows us to perform retrospective as well as current assessments. This technique is the preferred form of data gathering and analysis.
- Access to regional data as well as direct observation of the institutions themselves will be provided by PCI's performance of a service function -- acting as a centralized clearing house for information exchange among the three sites and providing half -time staff support (support, not guidance) to each of the three evaluation cells.
- We are not precluded from doing analyses in control and/or comparison sites or situations, but the details of such investigations, to be triggered by data availability from regional sites in order to make valid comparisons, must in any event be made after the start of the phase 3 activities: Hence, we have limited all direct samples (even of controls) to the post-experiment year (FY-1976).

- We are not precluded from direct observation and experimentation on site after the year of active experimentation, although preferred participation would be "piggybacking" upon regional evaluation activities;
- The planned experimentation in India and use of the CTS, offers a whole new realm of opportunities which can and should be separately considered.

4. Approach to Developing Key Comparisons

We have postulated that one of the important results of a technology demonstration such as the ATS-F will be that it injects a note of competition into what is conventionally an extremely non-competitive system -- education. This effect -- which our collegues at ETS call the John Henry effect -- should be readily discernible in its effects on comparable activities capable of providing regional communications, and to a lesser extent, on those providing comparable educational products and programs.

The best comparison then, in terms of (a) the John Henry effect, and (b) the ability of local committees to embrace the medium as well as the message, and (c) to a lesser extent, the way in which the "other" educational communities respond to these issues, are the alternative sources of educational television broadcasting. Hence, PCI's study plan calls for immediate collection of what can be called baseline data by sampling the public television broadcasts. Tape samples will be collected in the communities that will be receiving the ATS broadcasts, as well as selected control communities. Pre and post comparisons should then provide us insight into both the extent to which involvement with the medium has affected a commmunity's ability to impact other types of media and education, as well as another issue deemed important by our PCI investigators -- the degree to which one innovation can be used to spawn others. We are particularly interested, of course, in comparing those few sites where there is neither commercial TV nor public TV, to those sites where there were TV broadcasts prior to the demonstration. It is in these sites that we would expect the maximum impact of the "medium is the message" type of effect, as well as the maximum cost and benefit resulting from the homogenization vs. improvement and quality types of change. Note that is is only in the public TV realm that we have anything like true baseline data -- the institutions and individuals involved in the ATS experiment have already undergone much of the important change that we would attribute tc the impact of the technology per se. Inasmuch as we cannot predict in advance the types of change that we expect to be discernible in the public TV and other competitive forms of broadcasting, it is of utmost importance we have such information "in the can" and ready for analysis. Having established our basic hypotheses regarding these phenomena, during the course of our 24-month investigation we can retrospectively analyze the material "in the can" using content analysis and linguistic techniques. By carefully selecting the sites to be monitored, we will have both control and trend data, and controlled trends, for our comparisons.

5. Rough Notes on a Demand Analysis

Surprisingly, PCI feels that a great deal can in fact be done to predict the demand for satellite products, depending upon our ability to artfully infer from the demonstration what the true products really are. (That is, separating purchases of technology per se from purchases of programs, organizational image, etc.)

The demand is seen as consisting of two elements:

1. The price that local educational institutions would actually pay for products the satellite system and/or competitive systems could deliver;

2. Investment the private sector is willing to make in related technology,* on the assumption that the major investment in the satellite link per se has already been made.

In both cases, our general approach will be to develop plausible hypotheses as to both products and price ranges, based upon the demonstration, and then to test these in representative market situations, on nationally or at least regionally appropriate samples. (National and/or regional selection of samples will be based upon the relative size and characteristics of the market associated with individual products, and hence cannot be firmly specified until the demonstration has yielded some useful results as to the nature and plausible prices for products.)

We are fortunate in being able to call upon our experience for fleshing out both of the above noted models -- our experience with the Interactive TV Study in rural New England for our institutional demand model,and our study of investment and technology innovation**for sensing why and how private sector investment might be spawned by such activity.

The approach to assessing the demand of local educational institutions is shown in Figure II-1. As can be seen from Figure II-1, the basic output of the cost study -- plausible cost per viewer hour -- is the beginning of the sequence of events that culminate in a final statement of income that could be generated for applications of interest.

These basic data are synthesized in combination with the results of our institutional observations and analyses, to perform a cost/price analysis based on our earlier hypothesis that the value of such activities to

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* Related technology includes programs (including, for example, computer assisted instruction) for dissemination, alternatives to such (regional) programs, and alternatives to the chosen satellite.

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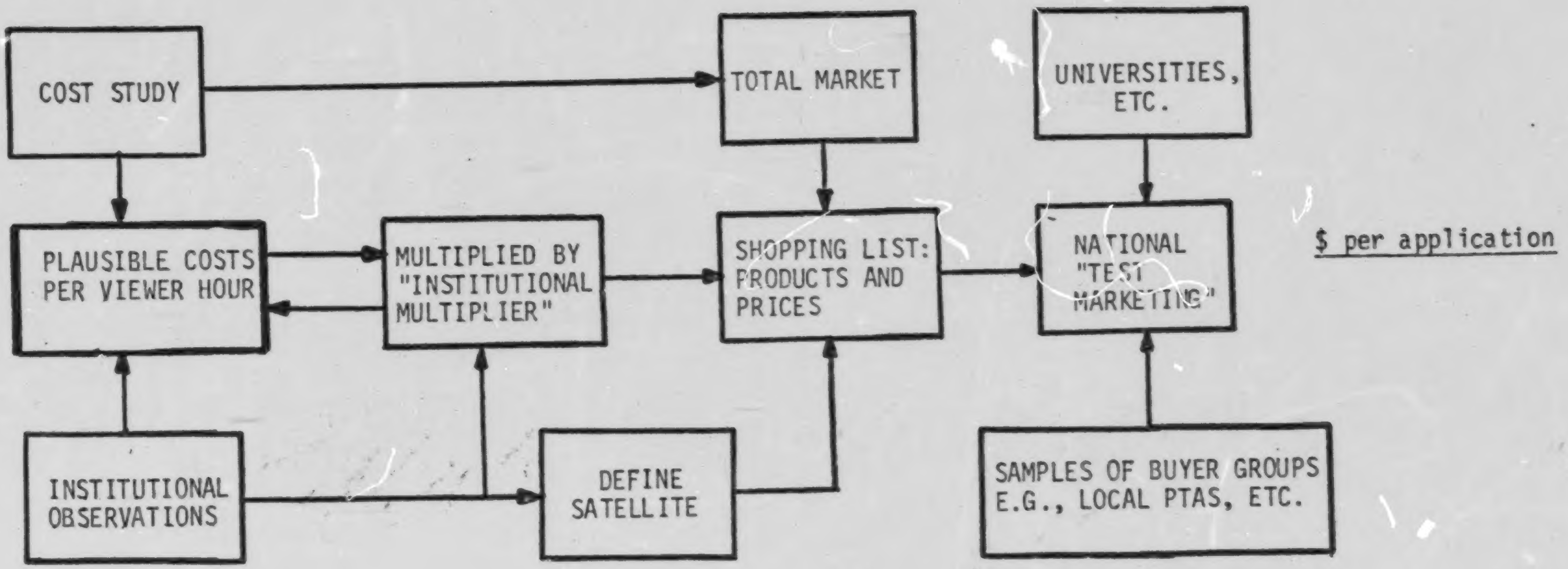

COST STUDY
TOTAL MARKET
UNIVERSITIES, ETC.
PLAUSIBLE COSTS PER VIEWER HOUR
MULTIPLIED BY "INSTITUTIONAL MULTIPLIER"
SHOPPING LIST: PRODUCTS AND PRICES
NATIONAL "TEST MARKETING"
$ per application
INSTITUTIONAL OBSERVATIONS
DEFINE SATELLITE
SAMPLES OF BUYER GROUPS E.G., LOCAL PTAS, ETC.

Figure II-1. SEQUENCE OF EVENTS FOR ASSESSING LOCAL DEMAND FOR "SATELLITE" EDUCATIONAL PRODUCTS.

institutions is greater than the aggregated value of applications to individual users (and based on the implicit hypothesis, also subject to test and verification during the institutional analysis, that cost is related to value). Hence, we will have basic price and cost data for developing a "shopping list" for later test marketing. The other inputs to the development of the shopping list include, of course, the potential size and description of the total market (an ancillary output of the cost study) and definition of the satellite products -- those things that individuals and institutions actually "buy" during the course of the demonstration. We are here alert to the probability, that to at least some extent, participants in this demonstration value and hence would pay for "products" other than the program material *per se*. Among alternative investments that may be made are investments in such intangibles as what we have defined as "image" -- a rational investment to the extent that it improves the effectiveness of the organization's ability to go about its business. (For example, to enhance its ability to retain qualified teachers.) [See Appendix B for PCI's discussion of "image".]

The second synthesis then divides the plausible products by the potential market for each of those products, to develop a national test marketing strategy. We then, will in fact undertake a national test market aimed at the specific buyer groups associated with the local educational institutions. *It is in the determination of the specific buyer groups that we obviate the need for a random national sample*. It is clear *a priori*, and we will rigorously test in the course of the evaluation that local PTAs accurately represent the attitudes and cost sensitivities of local schools in small rural communities. (Based upon our recognition that in most of these communities the school budget comprises the major portion of the total investment of the municipality, the PTAs generally include many if not most of current, prior and future board members,etc.). Note of course our assumptions about the local PTAs will be subject to validation during the early phases of the study. PTAs also are of great interest to us, as we would expect or at least hope to find that the *composition* of the local PTA has changed as a result of the ESCD.

Similar analyses will be undertaken for such intermediaries as the local RESAs in Appalachia, but a great deal more reliance will be placed upon the constituency of the individual school -- recognizing that they will be the hardest to sell. (And recognizing that there are alternatives for directly manipulating such superior organizational levels as State Boards of Education -- if only through federal subsidy.) As of this moment, the secondary target for the national test market will be universities and state school officials who might be in the market to "buy" audiences over such a communications device. We would probably be as confident in the inferences drawn from our demonstration, however, as we would be upon the results of an explicit large scale study in this regard.

The demand analysis will estimate the income that would be generated by different pricing strategies for different products. Hence, to the extent that we can expect that the local PTAs (and analogs) are representative of the school's buying patterns, and to the extent that we can have confidence in a simulated as opposed to a real choice, we will have a basis for an optimum pricing strategy for an operational satellite system.

With regard to the former assumption, the representativeness of the PTA groups, we feel this is a much more reliable indicator than, for example, asking the principals. The principal may change his mind overnight, and he is frequently replaced. Surely, the PTA best captures the points of view that will finally make school decisions.

With regard to the second of the above assumptions -- the extent to which a simulated choice such as that offered in a questionnaire can be used as a token for the actual choice -- we are again optimistic. We feel the choice will be dealt with in a rational way that pretty much simulates what these people would do in a real voting situation. Again, we must recognize that people in such rural communities are much more aware of school expenditures than are typical urbanites.

6. Selecting Survey Samples

The extensive interviews -- on-site, at control sites, and to assess national trends -- will be performed after completion of the 1974/75 "experiment year." This allows time to carefully formulate the hypotheses of interest and fully validate the ability of our selected questions to generate actionable data -- data that can be transformed into information. (Haste would not only make waste, but would also affect the experiment itself. More important, neither PCI, nor NIE, nor the local evaluators yet know enough to phrase appropriate questions.)

The basic interview sample approach is illustrated in Figure II-2. Our primary interest in this evaluation is in organizations and their interrelationships. Hence, our interview samples must be of individuals who can describe and characterize the nine interfaces between and among organizations as shown in Figure II-2. For the most important interfaces -- between the local community and the local school and between the local school and the rest of the educational establishment -- we have a uniquely appropriate survey group in the parent/teacher associations and such comparable activities as school boards. It is less clear as to the survey group appropriate for other institutions of interest (State and Federal school authorities, developers of programs, etc.). Clearly, we do not expect to find the same type of uniquely valuable interview group such as the PTA, which is at once fully representative of an institution (the local school) and in and of itself provides a certain degree of statistical reliability to the measurement.

PTAs and comparable groups in the ESCD experiment will be extensively sampled -- and in some sites we would expect to interview all PTA members. When extending results to a national sample, we will devise the sample in a way such that we can characterize both individual

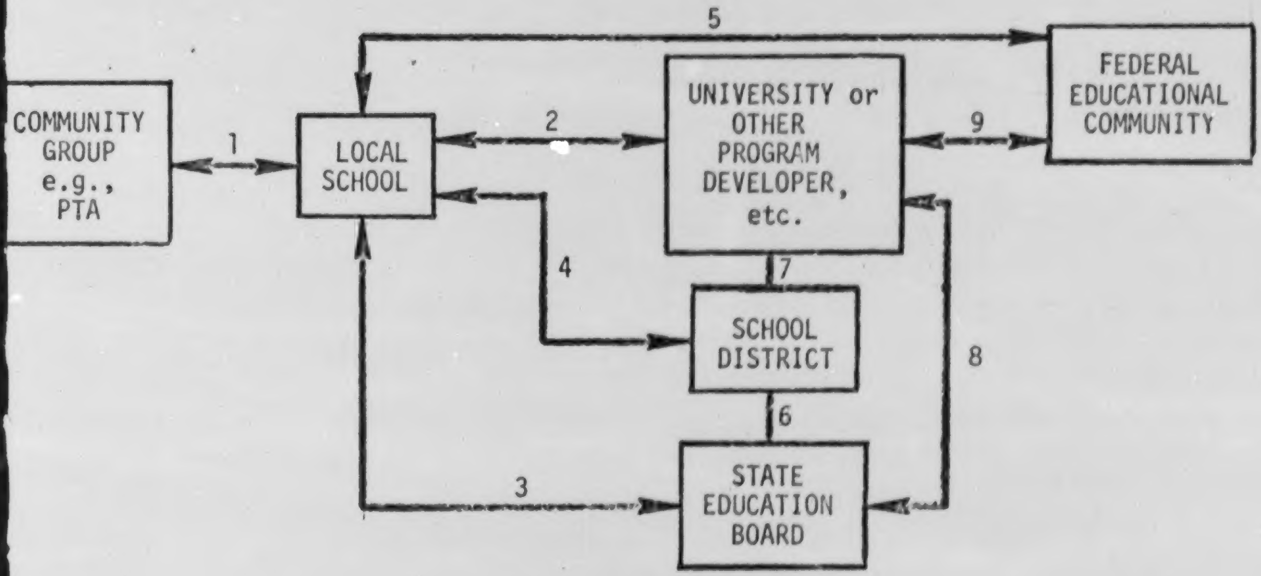

COMMUNITY GROUP e.g., PTA
1
LOCAL SCHOOL
2
UNIVERSITY or OTHER PROGRAM DEVELOPER, etc.
9
FEDERAL EDUCATIONAL COMMUNITY
5
4
7
SCHOOL DISTRICT
8
6
3
STATE EDUCATION BOARD

Figure II-2. Our interest in organizations as organizations allows us to focus on data gathering on samples that can characterize the interfaces between organizations. Hence our interest is not in the general attitudes of the community, but only as those attitudes find expression in such an organization as the PTA.

Samples must be chosen for each of the 9 "interfaces" shown here.

schools and at the same time make general statements about the PTA groups. Note, however, that it is more important to be able to characterize individual schools than it is to characterize PTA members, as the individual school is of course the unit that actually purchases such services. Given certain high-population PTAs strongly "sold" on regional broadcasts, one could easily lose the election while still winning the preponderance of the votes.

B. SETTING REALISTIC OBJECTIVES FOR THE EVALUATION

The quality of an evaluation should be judged by comparing the value of the information to the cost of evaluation activities. In order to conservatively assess the expected value of the evaluation we have designed, we here consider the evaluation products in terms of its prospective users, and define for each user the minimum information product we will provide. We address ourselves then to three specific types of users:

1. NIE qua NIE -- the agent charged with performing research that will ultimately improve the quality of education.
2. The general education community -- concerned with immediate improvements in education and the system by which educational improvements are effected.
3. Those who make telecommunications policy.

We also address ourselves to the 'intersections' between our three classes of users, discussing information products and issues of mutual interest and requiring joint or at least coordinated decision making:

4. The interface between NIE and the educational community.
5. The interface between NIE and telecommunications policy makers.
6. The interface between the education community and telecommunications policy makers.
7. The interface simultaneously involving all three of the above - NIE, telecommunications policy makers, and the educators.

There is one final perspective for which inferences may be drawn from a synthesis of all the preceding -- that of federal R & D strategy and policy. Hence, this section of our report also contains a brief discussion of:

8. Implications for federal research and development strategies.

1. NIE qua NIE -- the demonstration and educational research.

There are three research-oriented perspectives for the evaluation:

1. The extent to which payoff in terms of research results is attractive enough to warrant comparable types of investment (i.e., in comparable demonstrations);
2. Assessing the beneficial impact on the final consumer of such experimentation (that is, do people learn better as a result of the experiments undertaken during the demonstration);
3. Ways in which NIE intervention may beneficially affect the organizations involved in and/or impeding educational progress.

These issues are closely interrelated. In fact, it is PCI's view that the first of these issues subsumes the second. NIE's objective is to promote educational experimentation -- real change in the way educators go about their task of educating. NIE funds for experimentation are well spent if and only if their grantees both (a) actively experiment (do "innovative" things), and (b) properly assess their experiments. In this way NIE initiates a self-correcting process to create knowledge from which long-term educational impact will result.

The first priority of NIE investment is not to directly improve the quality of education to individuals or to teachers -- that is not high leverage utilization of research funds. Rather, the first priority is to create change and innovation from which we can learn more about the processes and mechanisms to benefit education.

PCI's approach to assessing value of NIE research invested is shown in Figure II-3.

The learning effect of the chosen experimentation is the proper and immediate interest of the grantee. NIE investments should ensure only that grantees do experiment and do assess their experiments so that we have started a constructive process. As in any form of research, to demand beneficial result is to preclude good experimentation. A conclusive demonstration of negative effect is certainly as important as a beneficial result with no transfer value.

Hence, the value of NIE investments will be measured in terms of the extent of innovation and effectiveness of the evaluation -- the real knowledge that has been gained rather than the educational effect. If there has been educational effect but it is not demonstrated then NIE has not bought a quality piece of research. On the other hand, if there is no educational impact, but it is demonstrated, either why there was no impact, or that a particular approach is of no value, then NIE has bought a high quality research product.

The two "steps" in the research process -- innovation and evaluation -- will be assessed. We will first determine the extent and degree of innovation that was spawned by our investment. We will then assess the quality of the evaluation and research activities through which the result of innovation was assessed. Weakness in one or both of these necessary elements of good educational research, can then presumably be attributed to flaws in the demonstration,the organizations involved, or NIE's approach to sponsorship.

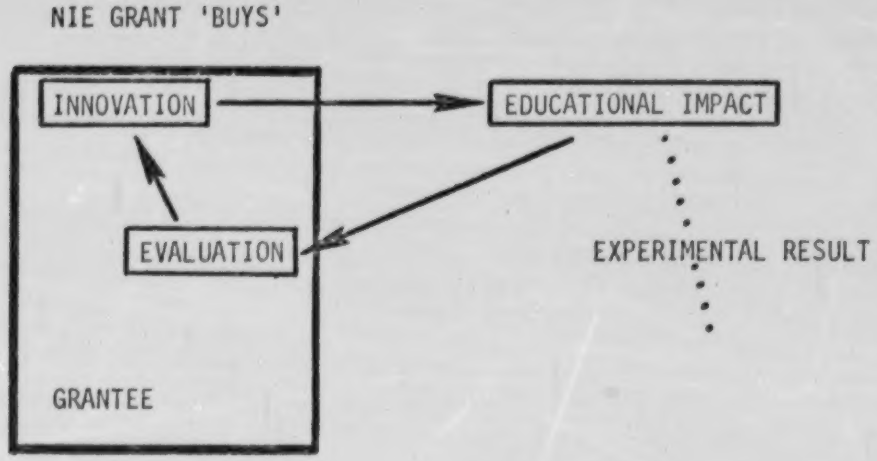

NIE GRANT 'BUYS'
INNOVATION
EDUCATIONAL IMPACT
EVALUATION
EXPERIMENTAL RESULT
GRANTEE

FIGURE II-3: NIE research funds should initiate a process of active experimentation, not guarantee educational result. Hence, NIE has spent its money wisely if grantees (a) innovate and (b) objectively evaluate the results of such innovation. Thus, our evaluation strategy is to see whether ESCD has effected innovation and evaluation. We are not basically interested in educational impact per se, except for information dissemination.

(When you evaluate neurological research you don't remeasure the neurological effect -- you ask if the researcher has increased your store of knowledge. NIE too is in the knowledge business and should evaluate expenditures in terms of learning about learning, not operational success.)

Our interest in innovation qua innovation, of course brings us to the third of the above noted NIE interests -- the extent to which changing the organizations themselves or interrelationships among organizations is of potential benefit to the educational process. We will directly assess the linkage by which ESCD investments change educational organizations and interrelationships -- hoping to change organizational behavior to initiate innovation aimed at educational improvement. We do not expect that educational improvement will be realized within the experiment year from such change in organizational attitudes and behavior. However, it is possible that if educational institutions become more responsive to their constituencies, rather than to sustaining the status quo ante, over a period of two-to-three years, adoption of the useful innovations should yield educational benefit. Thus, the effects and the indicators of effect that we would look for during the course of a three-year term, would include:

- Organizational attitudes: Organizations within the "educational system", should perceive themselves as being more responsive. We will examine (during the experiment year and the following year) the extent to which participating schools and local communities perceive the program producers, and superior educational institutions, to be more responsive to their local needs. During the course of the experiment, this will be done through content analysis of communications at the interfaces between such organizations. Subsequent to the experiment year, we will be performing direct attitude surveys to see if local schools (as represented by their staff, PTAs, and school boards) think that they can influence 'superior' institutions.

- Innovation or result-oriented change: The ESCD has already gotten off to a fairly unimaginative start in terms of the programs actually being produced. However, we anticipate a more important effect -- that organizational relationships will change so that local schools and program producers mutually perceive program producers as responsive to the needs of local schools. We expect this effect to be magnified by the rapid feedback available in some of the experiments, providing an atypical dynamism. That dynamic response may result in true innovation program modifications and broadcast techniques that focus on educational result rather than precedent. Hence, programs broadcast over the ATS-F, will be examined to determine the degree of experimentation -- deviancy from precedent and reduction in *a priori* assumptions. During the two years following the experiment, we will monitor activities of the most directly involved program producers, to see if there is tendency to continue the pattern. We will monitor the curricula and other educational outputs of these program producers, to determine the extent of observable change.

  During the first year, we will develop operational measurement techniques based upon our definition of innovation as "problem solving with a minimum number of *a priori* assumptions." If we can find some common problems addressed by program producers, we can recreate the analytical and decision making process by which they develop solutions to those common problems, to determine the number and type of *a priori* assumptions that have been made. During the course of the demonstration itself, we have one problem that will be faced at all of the sites -- what to do after funding for the experiment has terminated. We will examine the behavior of both program producers and selected local organizations to see if in fact the degree of responsiveness noted in the preceding assessment correlates well with innovativeness as measured by reduced number of *a priori* assumptions.

  To the extent that "innovation" involves use of regional communications *per se*, we expect to see further demonstrations initiated for use in later satellites -- for example, the CTS.

- Long-term education impact: If there are systemic or 'institutional' impediments to improving educational effectiveness, then over the long-term learners served by the more responsive organizations will learn more than learners served by non-responsive organizations. Hence, we will be interested in the second-generation educational effect of this experiment. After a series of interactions between program producers and local schools have resulted in changes in programs developed after the experiment, we will assess the effect of those programs on individual learners. Here we may be able to rely upon local "evaluations" and "data", but we cannot count on it inasmuch as at that point in the experiment neither the program producers, nor the schools involved, will necessarily perceive themselves as actively experimenting -- rather they will be improving operations. Here then, NIE's research interest again becomes focal -- to determine what this final effect is, whether it improves educational quality, and whether we can transfer experience to other sites or other types of learning.

In summary then, the 'values' that must be compared to the NIE costs in the demonstration include the following:

- Number and type of changes in methods of education;
- Quality of the evaluation of such changes, measured in terms of the conclusiveness of results, as well as direct judgements of that evaluation quality;
- Changes in perceived responsiveness of the educational institutions to their constituencies -- most specifically, changes between program producers and local schools involved in the experiment;

- Long-term changes in organizational attitudes and behavior consistent with the preceding;
- Actual responsiveness of educational institutions to their constituencies as measured by the continuing number and type of innovations;
- Long-term -- two years after the experiment -- the educational impact of operational innovations explored per the preceding.

2. Evaluation results of direct interest to the "educational community".

Certainly educators are interested in all issues that interest NIE. However, applying the criterion that we will attribute high value only to information for which there is a reasonable probability of a conclusive answer, there is little in the experiment of direct operational interest to educators in general. Even results conclusively demonstrating that there has been, for example, profound organizational change, may not suggest methods of immediately improving the educational system.

There is one question, of potential importance to educators, that should be answered reasonably conclusively:

- How much money is it feasible to invest in development of programs for general utilization throughout a given rural region? (Based on the ability to amortize the cost of programs over an extensive audience by using regional communications capability.)

Based on actual market study data, we will be able to make statements of the type:

> "For a satellite comparable in capability comparable to ATS-F, an investment of "N" dollars would be justified to achieve breakeven based upon the difference between satellite and current methods of dissemination."

"N" is in this equation simply the difference between the cost of delivering the program (via satellite) to some regional audience, as opposed to conventional alternatives. It is quite possible that "N" will be a negative number. The only trick here is that "N" will be calculated based upon a number of different units of cost -- per viewer hour, per school served,etc.

Another question of interest to educators, in terms of opportunity costs as well as potential benefit, is:

- Has the ESCD inspired private sector (or non-federal) investment in related or competitive educational technology?

3. Information for those formulating DHEW telecommunications policy.

There are three telecommunications policy questions addressed by this study:

- How much can we expect the educational community to contribute to regional communications, based upon "breakeven" costs as compared to alternatives?
- Are there specifications for the communications capability required by the educational community, such that educational demand can be aggregated with other HEW interests (i.e., other health and social service requirements) so that we can talk about an HEW communications network as an alternative to an educational communications network.

- On balance, do the advantages of regional communications appear to offset their potential disadvantages, particularly with regard to the risk of dysfunctional impact on communities?

4. The interface between NIE and the "educational community".

One issue at this 'interface' is whether and how large scale demonstrations of this type should be funded. The specific data developed by this evaluation will provide insight into:

- The strengths and limitations of using such grantee institutions as FRMS and ARC.
- The value of federal demonstrations of this type as a mechanism for stimulating a more result-oriented orientation within and among educational institutions. (Value in this sense will be both as perceived by the organizations involved and as actually measured by PCI in terms of constructive change effected in the demonstration.)
- Has the ESCD inspired private sector (or non-federal) investment in related or competitive communications-technology for use by educators?

A further question of mutual interest to these two communities is whether demonstrations of this type can result in both increased knowledge (consistent with NIE's research charter) and at the same time improve educational capability of participating institutions? This evaluation will identify the risks and rewards, benefits and costs, associated with the fact that the ESCD grants created new linkages among educational and non-educational institutions, and circumvented some limitations on interrelationships.

The total value will be the sum of (a) the value of research information plus (b) the value of programs developed, and (c) residual capacity that will accrue to the participating institutions. This total value will be compared to the cost of the demonstration.

The difficult thing to value will be the residual capability within the institutions. To address this issue we will compare the total output of the participating educational institutions (e.g., The University of Kentucky) during the experiment year and the post-experiment year, to the total output during the pre-experiment year.

For the purpose of this part of the analysis, we will assume educational effect to be constant, and will value an hour of programming at its "pre-experiment" cost. Hence, if a university developed 100 hours of career education programming during the pre-experiment year, 200 during the experiment year, and 150 at the post-experiment year, then we have doubled productivity during the experiment year, and increased it by 50% during the post-experiment year. By aggregating total program output in terms of total pre-experiment costs (e.g., $40,000 "worth" of teacher education, $60,000 "worth" of seminars,etc.), we will have a direct numeric indication of productivity (e.g., $100,000 in 1974; $200,000 in 1975, $150,000 in 1976,etc.).

5. NIE and telecommunications policy makers.

There is a long-term issue of what type of information should NIE be generating for the telecommunications community.

The short-term issues from which inferences may be drawn include:

1. Are satellite communications to be preferred to alternative means of achieving the same functional capability -- (in terms of glamour effect, ability to circumvent institutional or legislative constraints,etc.)?

2. Are any of the above long-term effects that would benefit operational as opposed to demonstration systems? If so, to what extent?
3. What is there in this demonstration suggesting that NIE should provide additional input to help formulate policy and strategies of telecommunications?
4. What information will this demonstration be generating that should be of value to experimenters and policy makers, both U. S. and others, involved in such immediately forthcoming experiments as the ATS-F operations over India, and the CTS?

Another issue to be addressed is the extent to which telecommunications policy makers can in effect create educational experiments such as the ESCD and then expect the NIE to find experimental value in them. Putting the issue more constructively, we will be able to say what type of interaction between telecommunications policy makers and NIE would have increased the value of the ESCD, with the hope that we can develop some plausible inferences for general interrelationships.

6. The intersection between the educational community and telecommunication policy makers.

Questions to be answered include:

- What is a preferred time cycle for creating a regional or national telecommunications capability, to optimize timing of educational investment that would amortize the cost of such operations?
- What total expenditure is it reasonable to expect the educational community to make in purchase of the communications capability per se?

- Would educational utilization of operational satellites have demonstration value of sufficient importance to impact secondary investments? Would the value of such secondary effect warrant consideration of subsidy based on an ability to accelerate telecommunications technology utilization?

7. The interface common to NIE, the educational community, and telecommunications policy makers.

All of the three types of decision makers should be interested in an investigation of one "alternative future". The specific questions to be addressed in this regard are:

- Is it plausible that national/regional telecommunications technology can cause the other educational technologies (e.g. programmed instruction,etc.) to coalesce into a single integrated and high-technology approach to education -- deinstitutionalizing the schools and providing a more personalized learner-oriented educational service?
- If the answer to the above question is yes, are there steps HEW can take to accelerate or impede that effect?
- Specifically, has federal involvement in the ESCD accelerated or impeded progress in educational utilization of technology based upon its stimulation or inhibition of innovative investment?

8. Implications for federal research and development strategies.

To preface this perspective, it must be recognized that DHEW has not generally used technology well, and has neither a coherent research and development strategy nor an effective means of implementing such strategies if one were to be developed. On the other hand, it can be argued that HEW 1974 is roughly analogous to the Department of Defense 1947, in terms of its ability to command funds for important national purposes, and its awareness that breakthroughs in technology exist but remain to be exploited in terms of coherent mission fulfillment.

Accepting our operating hypothesis -- that the educational systems and organizations are impeding rather than abetting the process of educational improvement, the research and development strategy question addressed by this study is:

- Whether and how federal research and development investments can create technology that will deliberately compete with institutions and institutionalized ways of doing business, to return us to Schumpater's model of "self-destructive capitalism."

The specific data generated by this study will be the extent to which the ESCD, by competing with the institutionalized ways of doing business, has modified the oligopolistic structure of contemporary education to inject beneficial elements of a free market approach.

There is a revolutionary note in this discussion. The U. S. Government and the U. S. universities system have grown large together, based largely upon Department of Defense sponsored investment, and supported by HEW investments in research and educational facilities. The Office of Education has made massive investment in local education, much of it admittedly marginal and based upon congressional perceptions that certain levels of input are obviously good and with little orientation to educational result in terms of real benefit to learners. The question before us is whether HEW can develop a research and development strategy that improves the orientation of the educational community, by properly using technology, toward missions and results rather than institutional development. The Department of Defense starts with mission requirements and then makes less than optimum decisions based on political factors (e.g. keeping open a given ship construction facility). Educators make basic decisions based upon political factors (such as supporting the right institutions in the right way) and then manipulate those choices at the margin to achieve educational benefit. A research and development strategy should create innovations that will continually test and challenge the existing institutions, so that survival of those institutions would ultimately depend on educational effect.

C. PHASE II CONCLUSIONS: DEVELOPMENT OF AN EVALUATION STRATEGY AND PLAN

This section of the report presents the overall evaluation strategy developed during our study. This information is presented in three sections:

A. The ESCD Technology

B. Focus of the Evaluation: Impact on the Educational 'System'.

C. Implications for Data Gathering

1. The ESCD Technology

It is the conclusion of our study that the ATS-F is not importantly representative of future satellite systems upon which educational operational capability is liable to be based. It was our further conclusion that except for a few of the thirteen basic experimental modules involved in this demonstration, the educational programs being broadcast over the ATS-F are far more representative of the current state of the art than they are prototypes of future programs. Thus the ESCD is demonstrating neither the ability to broadcast video via satellite -- that surely has been proved conclusively prior to ESCD -- nor the ability to develop new types of programs. The question then is just what is being demonstrated and experimented with?

There are two unique communications capabilities provided by satellite systems. First, costs of communications by satellite do not vary with line length -- it costs basically the same amount to link Manhattan with Staten Island as it does with San Francisco. Second, satellite communications can provide extremely broad coverage -- reaching numerous sites in otherwise isolated areas. The ESCD is focused rather more on the latter application -- mass distribution and ability to reach large audiences -- than it is on the former. Hence, in the technological aspect of the study what is under test is the relative value and need (market for) ground stations.

Audience size varies with number of ground stations. The greater the audience size, the larger the satellite (and program) investment that can be justified. Hence, the key to use of the technology is the ability to define and 'sell' ground stations to local educators.

2. Focus of the Evaluation: Impact on the Educational 'System'

Extensive experimentation in ways of improving effectiveness of education has yielded no conclusive evidence as to how such improvements can be effected. Where improved effectiveness of education has been realized, it seems to be a function of better management rather than better educational techniques *per se*.

a. Based upon the largely admitted failures of an enormous diversity of attempts to improve educational effectiveness, and upon the perception that educational effectiveness *is* susceptible to improvement by 'better management', it follows that the impediment to improving educational effectiveness is inherent in the way educational organizations and institutions are organized and interrelated. That is, it is the educational 'system' itself -- the way organizations behave and interrelate -- that is (inadvertently) defeating our attempts to improve the educational process.

b. One thing that the ESCD will almost certainly do, is change the nature of the interrelationships among educational organizations involved in the experiment, and to some extent modify the behavior within the organizations, and possibly the behavior of local schools *vis a vis* the local communities.

c. Hence, the ESCD, by circumventing conventional organizational relationships and dissemination techniques, affects the variable that should be of primary interest to the educational community -- organizational functions, inertia, and interrelationships.

d. Hence, the ESCD is a unique experimental test bed, directly addressing the crucial impediment to educational improvement.

3. Implications for Data Gathering

a. Our measures of the impact of satellite TV on the educational community will concentrate on questions such as the following:

(i) Does satellite TV change local teachers perceived power in relation to the traditional educational establishment such as boards of education and universities? For a discussion of how an institution's image effects its performance, see Appendix A.

(ii) During and following the demonstration do local school teachers make demands of the traditional educational establishment which are similar to demands they can make of the ESCD grantee?

(iii) Does satellite TV increase the prestige of participating organizations and personnel in the eyes of local and educational communities?

(iv) Does satellite TV participation stimulate innovative approaches to solving educational problems on the part of the grantee institutions, and on the part of local schools?

(v) Does satellite TV cause telecommunications and educational institutions to compete with it, and consequently improve efficiency or find innovative solutions to problems? And do the competitors change educational institutions the way we hypothesize that satellite communications will?

b. We will study whether and how federal decision and funding strategies have allowed and stimulated people and institutions to find innovative uses for satellite TV.

A working hypothesis is: To the extent that we subsidize the use of technology, the net effect on the organization's internal operations will be reduced. An institution that cannot add staff, or otherwise "insulate" itself when faced with the technology, must change something if it is going to use that technology. On the other hand, an organization that is given funds to "adapt to" that technology need not in fact adapt. It can instead create a buffer organization between it and the technology, so that we have added to the organization but not changed anything that pre-existed.

c. We will consolidate and synthesize conventional measurement of learning done by local evaluators, but will do none ourselves.

d. We will loan one PCI staff member to each of the three grantees on a half-time basis. Depending on work necessary, and the obtrusiveness of the arrangement, PCI presence during the demonstration might be scaled down to 1/3 time.

e. In our attempts to predict the future demand for satellite TV we will pay special attention to:

(i) Groups of people who share common educational needs, but do not happen to live together in the same region (occupational groups, people suffering from similar handicaps,etc.)

(ii) The future prices of ground installations, and the possibility that direct reception of satellite-relayed materials may one day be available at popular prices. We will try to estimate if it will happen, when it might happen, and how it might happen. And we will try to predict its social benefits and costs.

f. In our demand and economic analyses we will answer questions such as the following:

(i) How much can we expect the local educational community to contribute to regional communications based upon "breakeven" costs as compared with alternatives?

(ii) How much can we expect the satellite and broadcasting industries to contribute to regional communications based upon "breakeven" costs as compared to alternatives?

(iii) How much can we expect producers of television programs and educational materials to contribute to regional communications based upon "breakeven" costs as compared to alternatives?

And we will try to answer:

(iv) Based on perceived social value, how much and for how long and under what conditions can we expect federal support or subsidy of satellite TV?

SECTION III

DATA COLLECTION AND ANALYSIS

The purpose of this section is to outline the data collection and analysis tasks, and how they fit together. The tasks derive their form and direction from the conclusions about ESCD, and the objectives for evaluation set forth in sections IIB and IIC. Before discussing the tasks themselves, we will summarize the data base, define data areas, and show how the data areas relate to each other.

The Data Base: ESCD Summarized

The satellite TV audiences, the programs transmitted, and the program schedules are summarized in Table III-1. Basically there are:

-13 programming efforts (Rockies-4, Appalachia-4, Alaska-5), and
-88 receiving sites (Rockies-56, Appalachia-15, Alaska-17).

Data Areas

We have divided ESCD into four primary data areas for the purpose of measuring the impact of satellite TV on educational institutions and on how educational institutions are perceived.

1. Impact of satellite TV on how people perceive educational institutions and technology (includes estimation of demand for satellite TV);
2. Impact of satellite TV on educational institutions and behavior toward them;
3. Use that is made of satellite TV;
4. Events and decisions that led to ESCD.

TABLE III-1

APPALACHIAN REGION COMMISSION

IV. PROGRAMS WHO RECEIVES	WHAT	WHEN
A. Elementary Career Education - Summer Program 20 teachers at 15 RESA sites = 300 teachers.	A. Elementary Career Education - Summer Obj - Teachers develop material applicable to school setting - Teachers prepare staff development materials fur local use. Content- Principles, concepts, practices of career education in elementary schools. Format- Highly illustrated lectures and interaction.	A. Elementary Career Education - July 11-Aug. 22 1. Each Thursday for 8 weeks 2. Teacher workday 8:30-3:30 3. TV and lab work 4. Total 16 programs 5. 4 line seminars
B. Elementary Reading - Summer Program 1. 20 teachers at 15 RESA sites = 300 teachers.	B. Elementary Reading - Summer Obj - Teach diagnostic and prescriptive models - Acquaint teachers with select Ed/Texas Info Retrieval system for location of prescriptive models. Content - Models for diagnosis/prescription Format - Practical classroom 4-channel audio reinforcement	B. Elementary Reading - Summer July 11-Aug. 22 1. One day each week 2. 12 30 minute video broadcast tapes- 12 15 minute audio - Q-A 3. 12 15 minute 4-channel audio sequence after tapes. 4. 4 50 minute seminars at strategic points. 5. Total 16 video 12 4-channel audio
C. Jr. High Career Education 1. 20 teachers at 15 RESA sites = 300 teachers.	C. Jr. High Career Education Obj - Theories/techniques of decision making Content - 1/2 unplanned 1/2 implementation procedures Format - Lectures,panels, video episodes	C. Career Education Jr. High Sept. 10-January 7 1. 16 live 45 minute video seminars plus interaction 2. Tuesday each week 3. Evenings
D. Sr. High Career Education 1. 20 teachers at 15 RESA sites = 300 teachers. 2. By Whom: University of Kentucky	D. Sr. High Career Education.	D. Career Education - Sr. High January 21 - May 13 1. 16 live 45 minute video seminars and interaction 2. Tuesday each week 3. Evenings

TABLE III-1 con't

ALASKA		
IV. PROGRAMS WHO RECEIVES 1. Exact audience sizes unknown. 2. Though targeted, range can be 0-total population.	WHAT	WHERE-WHEN 1. All in schools 2. Perhaps 1 in Anchorage hospital 3. Possible commercial TV hook-ups, not clarified yet.
A. Early Childhood 1. 3-5 year olds 2. Mothers	A. Early Childhood Objective - Increased respect for traditional culture Content - Native legends in native language. Format - Puppets/on-location film/ actors	A. Early Childhood 1. 30 minute program per week Thursday - mid-afternoon
B. Oral Language Development 1. 5-7 year olds	B. Oral Language Development Objective - Teach basic English reading/writing Content - Songs/dialogues/ electronic effects Format - Host - 5 puppets	B. Oral Language Development 1. 2 30-minute programs per week Monday and Friday between 10:30-12:00
C. Health Education 1. 8-10 year olds	C. Health Education Objective - Promote good health habits,etc. Content - Half medical "canned", half new Alaska specific Format - Host - 2 puppets	C. Health Education 1. 2 30-minute programs per week - Monday and Friday between 1:30-12:00
D. Native Magazine 1. Adults	D. Native Magazine Objective - Increased awareness of Native concerns. Content - 3 prepared/the rest to be selected. Format - Explanation by host plus films.Audio interaction	D. Native Magazine 1. 1 hour program per week
E. Teacher In-Service 1. All teachers	E. Teacher In-Service Try to meet specific needs as they arise. No formal curriculum. Expected that exchanges will deal with problems of using ATS-F programs.	E. Teacher In-Service

TABLE III-1 con't

FEDERATION OF ROCKY MOUNTAIN STATES

PROGRAMS WHO RECEIVES	WHEN	WHAT
A. Career Development Course 1. 56 closed sites - 30 students per site (1,680 different standards per semester) 2. 1/2 integrate course into existing curriculum. 3. 1/2 offer course as an elective. 4. Sites on contract to participate. 1. 56 open sites (PBS Broadcast)- 30 students per site 2. No data on whether elective/integration 3. Schools under no obligation to participate 4. PBS broadcast will probably be lin.	A. Career Development Course Sept. 9 - Jan. 17, Jan. 20-May 17 1. 35 minute daily program for 16 weeks. 2. Total 81 programs 3. Broadcast between 9-10.	A. Career Development Course Objective - Career development decision-making process. Content - Behavioral objectives/reinforcement. Format - Segmented - Sesame Street/time machine. Interaction period.
B. Teacher In-Service 1. Voluntary 2. Hoping for 10 teachers per closed site (Range 0-?) a. Site coordinator responsibility to produce teachers. 3. PBS not committed to broadcast yet. 4. No concrete incentives for attendance a. Site coordinators trying to obtain credits from local colleges.	B. Teacher In-Service Objective - Aid teachers to prepare students in making choices. Content - Information availability, teaching techniques. Format - Illustrated lectures, seminars.	B. Teacher In-Service September ? 1. 55 minute weekly show. 2. Tuesday or Thursday 3. Total 16 shows 4. Broadcast 4:15 - 5:10
C. General Audience Programs 1. Estimate 750 at closed - based on survey. 2. Estimate 17,000 open - based on PBS general viewing habits - station commitments to broadcast as of now.	C. General Audience Programs Objective - Inform community on relevant topics. Content - Topic examples: early childhood, environment, consumer affairs, aging. Format - Illustrated lectures, films, panels.	C. General Audience Sept. 26-May 15 1. 1:45 per show 2. One time each 3 weeks 3. Tuesday or Thursday evening 4. Total 11 programs
D. Materials Distribution 1. Any teacher making a request. Specific demographic information not available until the first week of school.	D. Materials Distribution Objective - Make audio/visual resource materials available to schools.	

Independent Variables and Dependent Variables

The primary causal relationships, or independent variable - dependent variable relationships, we will study are listed below. Obviously, ESCD is not an experiment where there are clearly delineated causes and effects. In fact, all the elements listed below may effect, in one way or another, all the other elements. The paradigm does, however, show how the areas of data we will collect and analyze fit together.

INDEPENDENT VARIABLES	DEPENDENT VARIABLES
A. Events and decisions that led to ESCD.	Use that is made of satellite TV.
B. Events and decisions that led to ESCD and Use that is made of satellite TV.	Impact of satellite TV on educational institutions and behavior toward them.
C. Events and decisions that led to ESCD and Use that is made of satellite TV.	Impact of satellite TV on how people perceive educational institutions and technology (includes estimation of demand for satellite TV).

Data Collection and Analysis Tasks

Below is a list of the data collection and analysis tasks we will undertake. They are grouped by the type of activity they will require of PCI staff.

A. Four of the data collection and analysis tasks we will perform correspond to the data areas described in previous paragraphs. They represent our most active collections of data, and the data areas which are most central to the measurement of the impact of satellite TV on educational institutions and how educational institutions are perceived.

1. Measurement of the impact of satellite TV on how educational institutions and technology are perceived (includes estimation of demand for satellite TV);
2. Measurement of the impact of satellite TV on educational institutions and behavior toward them;
3. Calibration of the use that is made of satellite TV: Content analysis of the programming;
4. Retrospective study of the events that led to ESCD: Analysis of documents.

B. Three tasks primarily requiring monitoring and synthesizing data collected by local evaluators:

5. Economic analysis;
6. Engineering analysis;
7. Synthesis of educational impact assessment done by local evaluators.

C. Three tasks requiring coordination and dissemination of information:

8. Exchange of information among the grantees;
9. Quarterly progress reports to NIE, the grantees, and whomever else is interested;
10. Seminars and conferences.

SUMMARY: DESCRIPTIONS OF MAJOR DATA COLLECTION AND ANALYSIS TASKS:

In the next paragraphs, the major data collection and analysis tasks are summarized. Each of the major tasks is the topic of a full section later in this report.

Task #1: Measurement of Impact of Satellite TV on Institutions:
Measured by: Records that are either collected as a matter of course by local institutions or by local evaluators;
Units of Analysis: 56 local schools in the Rockies, 17 local schools in Alaska, 15 teacher training sites (RESA) in Appalachia, and grantee and programming institutions in all three regions;
Controls: Comparable schools outside the demonstration for the Rockies and Alaska.

Task #2: Measurement of Impact of Satellite TV on how Educational Institutions are Perceived:
Measured by: Conventional questionnaires in the Rockies and Appalachia, and by linguistic analysis (an unobtrusive substitute for questionnaires) in Alaska;
Units of Analysis: 56 local schools in the Rockies, 15 teacher training sites in Appalachia, two Eskimo and Athabaskan sub-cultures in Alaska.

Task #3: Calibration of the Use that is made of Satellite TV:
Measured by: Content analysis which is an objective, reliable, computer-aided method for characterizing and quantifying messages of media transmissions;
Units of Analysis: There are 13 different programming efforts; however we will content analyze only three or four of the more intensive efforts, at least one per region. It is probable that career education in the Rockies, and the Alaskan Native Magazine will be two of the programs content analyzed.

Task #4: Retrospective Study of the Events and Decisions that led to ESCD:
Measured by: Systematic characterization of documents, and comparisons to other productive and non-productive (in terms of transferable information) demonstrations.

Task #5: Economic Analysis:
Measured by: Interviews, questionnaires, and review of records for NASA, NIE, regional contractors, and user sites;
Comparisons: Alternatives to satellite TV: a) Outside the demonstration, b) For user sites before and after the demonstration.

DESCRIPTION OF SECONDARY DATA COLLECTION AND ANALYSIS TASKS:

In the next paragraphs, data collection and analysis tasks which are not central to the major thrust of our evaluation are described.

A. Two tasks which primarily require monitoring and synthesizing data collected by local evaluators are:

   1. Engineering analysis;
   2. Synthesis of educational impact assessment.

1. Engineering Analysis:

A design for economic/engineering analysis submitted by ECON, Incorporated, comprises a later section of this report (Section IX). It is PCI's intention to honor the spirit of the ECON report by in fact accomplishing the engineering, economic analyses, and various trade-offs studies set forth in this document. However, based on our strategy of non-intervention in the experimental site, rather than going forward with an on-site engineering analysis, we will rely upon the regional evaluation capability, and PCI participation in regional evaluation teams to generate the engineering and cost data required for this study.

In addition, we will help regional evaluators learn from each other about collection, analysis, and intrpretation of data by:

   a. Putting appropriate people in direct contact with each other and,
   b. Including engineering topics in progress reports sent out to the regions on a quarterly or as-needed basis.

2. Synthesis of Educational Impact Assessment:
   We will do no assessment of impact of satellite TV on learning because we feel:

   a. It is being handled adequately by the grantees;
   b. It is not central to the issues addressed by ESCD;
   c. The self-evaluation by grantees is an intregal part of the demonstration and should not be obscured;
   d. There is no basis for comparison of learning impact across regions.

It is clear, however, that the regions' educational impact data deserves presentation in any central evaluation of ESCD. And it is also clear that the data will gain in usefulness by being presented as a unit where common issues can be traced.

As a part of our program of conferences for media experts (the "Gatepost Group", which is described in Section X-A) and ESCD participants, we will provide funds and facilities to allow regional evaluators to consolidate their work. In addition, as a service to regional evaluators, we will help them learn from each other during the course of the demonstration by:

1. Putting appropriate people in direct contact with each other, and
2. Including education research topics in progress reports sent out to the regions on a quarterly or as-needed basis.

B. Three tasks which primarily require coordination and dissemination of information are:

1. Exchange of information among the grantees;
2. Quarterly progress reports to NIE, the grantees, and members of the "Gatepost Group";
3. Seminars and conferences.

The exact format of the above will depend on the needs of all involved. At the beginning of the demonstration we will take a poll, and then design schedules and formats.

1. Topics for information exchange among grantees might be:
    a. How to solve equipment problems;
    b. How to solve educational measurement problems;
    c. Procedures for taking advantage of interactive TV.

2. Topics for quarterly progress reports to NIE, the grantees, and members of the "Gatepost Group" might be:
    a. Preliminary conclusions;
    b. Useful research methodology such as content and linguistic analysis;
    c. Summarized minutes of "Gatepost Group" meetings;
    d. Pertinent magazine, newspaper and journal articles about ESCD, satellite TV, etc.

The purpose of conferences and seminars,which we will hold at least quarterly and perhaps monthly during the demonstration,will be to increase communication between ESCD and the education, communications, and governmental communities. A group (called the "Gatepost Group") of experts in education, communications, anthropology, etc., with widely differing views about satellite television,have already been identified for the conferences (see Section X-A). In addition, we will invite people from the demonstration sites, from government agencies, and from the private sector.

The next six sections of this report are devoted to detailed descriptions of our major data collection and analysis tasks.

SECTION IV

MEASUREMENT OF THE IMPACT OF SATELLITE TV ON THE WAY EDUCATIONAL INSTITUTIONS AND TECHNOLOGY ARE PERCEIVED:

A. QUESTIONNAIRES

The general question posed in the questionnaires is: Does satellite TV change the way people perceive their local educational institutions, and the way they see high technology such as satellite TV? In particular: Does satellite TV make educational institutions and technology seem more accessible to local community control? And does satellite TV make educational institutions and technology seem more responsive to local needs? Additional questions will be derived from content analysis of the satellite TV programming.

We will administer the questionnaires at the end of the demonstration (June 1975), and then one year later, to several groups. The groups are:

1. Satellite TV audiences:
    a. Rural Junior High school students receiving career education via satellite TV in the Rockies (approximately 1,680 students), and
    b. Rural teachers receiving in-service training via satellite TV in Appalachia (approximately 300 teachers). Questionnaires will be pencil-and-paper, administered by the teacher.

2. Teachers who have contact with satellite TV:
    a. Rural teachers in the Rockies teaching in classes served by satellite TV (approximately 56 teachers),
    b. Rural teachers in Alaska teaching in classes served by satellite TV (17 teachers), and
    c. Rural teachers receiving in-service training via satellite TV in Appalachia (the same 300 teachers as above except the questionnaire is different). Questionnaires will be pencil-and-paper, administered at the same time as #1.

3. People in communities served by satellite TV who are interested in and influence educational institutions: Rural PTA's and analogous groups in the Rockies (# of members not known). Questionnaires will be pencil-and-paper, administered at PTA meetings.

   Handling of the audience and community in Alaska will not be via questionnaires and is discussed elsewhere (see Linguistic Analysis ,Section IV- We will not administer questionnaires to the communities in Appalachia, because their contact with satellite TV is too indirect. (Teachers leave the communities and go to a central location to receive satellite TV in-service training.)

COMPARISONS: RANDOM HALVES

For group 1a, 1b, 2a, 2b, and 3, we will split the groups into randomly chosen halves for the:

a. End of demonstration questionnaire, and
b. The one-year-after questionnaire.

The purpose of this procedure is to ensure that effects are due to passage of time following disappearance of satellite TV, and not due to repetitions of the same questionnaire. Random halves will be accomplished in Appalachia and the Rockies by using half the satellite TV-served classrooms for the end-of-demonstration questionnaire, and the other half for the one-year-later questionnaire. In Alaska, there are not enough satellite TV-served communities (17) to allow splitting the teachers into random halves. To help us interpret the Alaskan teacher's data, we will try to assess the effect of repeated measures by giving the questionnaires to some teachers in the Rockies at both times, and then comparing their second time answers to other one-year-after answers.

COMPARISONS: CONTROL GROUPS

Control type comparisons are: (the numbers refer back to the list at the top of page A-1)

1a: Intensive sites (interactive audio channel) vs. Receive Only sites vs. not in demonstration.

1b: Teachers in the demonstration vs. teachers not in the demonstration, but also receiving some type of in-service training.

2a: Intensive sites vs. Receive Only sites vs. not in the demonstration.

2b: In the demonstration vs. not in the demonstration.

2c: In the demonstration vs. not in the demonstration, but also receiving some type of in-service training.

3: Intensive sites vs. Receive Only sites vs. not in the demonstration.

Finding comparable groups outside the demonstration is a problem we do not pretend to have solved. However, for 1a, 2a and 3, the seriousness of the problem is lessened by the three-celled nature of the comparison. Where the probability of a pair of cells being ordered by chance in a particular way is 1/2, the probability for three cells is 1/6. And for 1b and 2c, the problem may be solved by including only teachers participating in teacher training. Also, we will always use differences between scores (score for end of demonstration minus score for one year later) rather than absolute scores, which corrects for differences between control and demonstration samples.

NOTES ON INTERPRETATION

a. If perceptions of local education, its responsiveness to local needs, and local control over it have deteriorated during the one year after the end of the satellite TV demonstration, it reflects positively on satellite TV.

b. If perceptions of local education, its responsiveness to local needs, and local control over it are the same or enhanced during the one year after the end of the satellite TV demonstration, it reflects negatively on satellite TV.

The above comments are over-simplifications, and are expanded upon below. They do, however, give a feel for our approach to assessing perceived value of satellite TV. We are assessing effect of satellite TV via the impact of removing it.

ANALYSIS OF QUESTIONNAIRE TYPE DATA

We will collect questionnaire data about the impact of satellite TV on perceptions of educational institutions and of technology at the end of the demonstration (June 1975) and then one year later. Following are:

1. A graphic representation of possible data outcomes and their implications for satellite TV, and

2. A statistical representation of possible data outcomes and their implications for satellite TV.

Graphic Analysis

The questionnaire item we will talk about for explanation purposes here is: (For Junior High School students in the Rockies) Where would you get a better education, here or in Denver? Much better here, a little better here, a little better in Denver, much better in Denver. We will always work with the difference between schools in the demonstration and schools in a control group.

d_2 = The difference between the demonstration school's average and control school's average for June 1975. (End of demonstration)

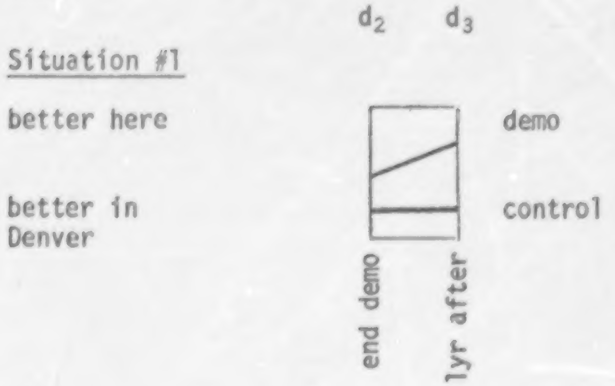
d_3 = The difference between the demonstration school's average and control school's average for June 1976. (One year after the end of the demonstration)

Graphic Analysis of Questionnaire Data

(It will be helpful to compare this page with page A-9, graphic analysis for unobstrusive measurements.)

DATA

Situation #1



INTERPRETATION

Very positive reflection on satellite TV. Apparently it has made rural schools look better compared to Denver schools, and the improvement continues after satellite TV leaves.

DATA

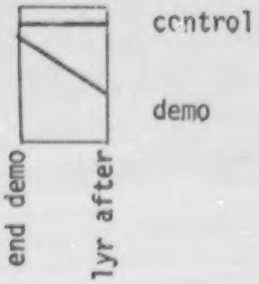
INTERPRETATION

d_2 d_3

Situation #2

better here

better in Denver

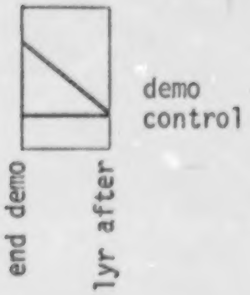

control
demo
end demo
1yr after

Very negative reflection on satellite TV. Apparently it has made rural schools look worse compared to Denver schools, and the deterioration continues after satellite TV leaves.

Situation #3

better here

better in Denver

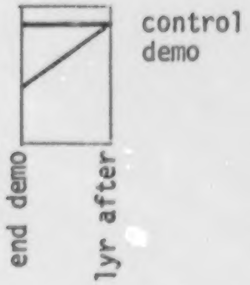

demo
control
end demo
1yr after

Positive reflection on satellite TV. Apparently it has made rural schools look better compared to Denver schools, but the improvement subsides after the satellite TV leaves.

Situation #4

better here

better in Denver


control
demo
end demo
1yr after

Negative reflection on satellite TV. Apparently it has made rural schools look worse compared to Denver schools, but the deterioration disappears after satellite TV leaves.

DATA

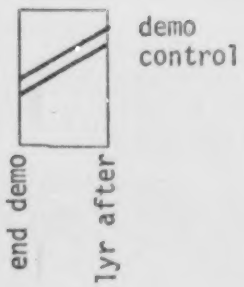
INTERPRETATION

d_2 d_3

Situation #5

better here

better in Denver

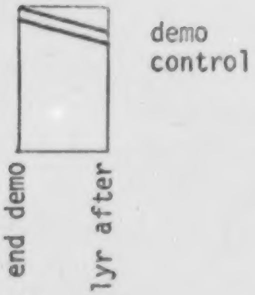


Neither positive nor negative reflection on satellite TV.

Situation #6

better here

better in Denver

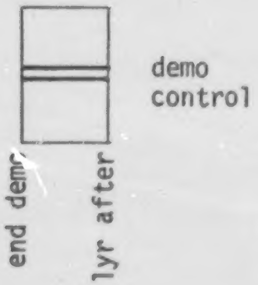


Neither positive nor negative reflection on satellite TV.

Situation #7

better here

better in Denver



Neither positive nor negative reflection on satellite TV.

A majority of the questionnaire items proposed can be graphically analyzed in the above fashion. Conclusions require the statistical analysis which follows.

STATISTICAL ANALYSIS OF QUESTIONNAIRE DATA

Situation #1

$$F = \frac{d_3 - d_2}{\sigma_{d_3 - d_2}}$$

Positively significant, demo > control.

Situation #2

$$F = \frac{d_3 - d_2}{\sigma_{d_3 - d_2}}$$

Negatively significant, demo < control.

Situation #3

$$F = \frac{d_3 - d_2}{\sigma_{d_3 - d_2}}$$

Negatively significant, demo > control.

Situation #4

$$F = \frac{d_3 - d_2}{\sigma_{d_3 - d_2}}$$

Positively significant, demo < control.

Situation #5, 6, 7

$$F = \frac{d_3 - d_2}{\sigma_{d_3 - d_2}}$$

Not significant.

QUESTIONNAIRE DESIGN

Listed in this section are prototype questionnaire items for:

1. Satellite TV audiences.
2. Teachers who have contact with satellite TV.
3. People in communities served by satellite TV who are interested in and influence education.

The items are multiple choice, but sometimes without the multiple choices. We will arrive at the multiple choices toward the end of the demonstration by asking the questions of small samples in an open-end pretest, and then using the five (more or less) most common answers to each question as multiple choice answers for the final questionnaire. To design all the multiple choice answers now would:

1. Result in items that have nothing to do with the realities of people in the Rockies, Appalachia, and Alaska.
2. Rule out the very changes we are looking for, since they haven't occurred, and we don't know what they will be.

All of the items can be administered to people outside as well as inside the demonstration. For example, we do not ask what satellite TV is good for, but rather what TV in general is good for. The difference between the demonstration and control answers will tell us what people inside the demonstration think satellite TV is good for. You can, of course, just ask people inside the demonstration what they think satellite TV is good for, but the answer you get has almost no power.

PROTOTYPE QUESTIONNAIRES: (to be worked into final form during the demonstration year)

Questionnaire for Satellite TV Audiences and Control

1. If you lived in (name the nearest city), what would you be studying that you can't study now? Pick more than one if you want: Nothing, _______, _______, etc., other_______.

Interpretation: If satellite TV responded to local educational needs, then more people should give more answers after the satellite has left, and outside the demonstration.

Byproduct: Comparison of choices inside and outside the demonstration will show how satellite TV has changed preferences.

2. If you lived in (name the nearest city), what would you be doing outside class you can't do now? nothing, _____, _____, etc. other_____.

   Interpretation: same as #1.

3. Where would you get a better education, here or in (name nearest city)? Much better here, a little better here, a little better in the city, much better in the city.

   Interpretation: If satellite TV provided services needed in isolated areas, then more people should answer "better here" inside and before the end of the demonstration.

4. If you lived in (name the nearest city), what career opportunities would you have that you don't have now? Pick more than one if you want: None, _____, _____, etc. Other_____.

   Interpretation: If satellite TV provided services needed in isolated areas, then more people should answer "none" inside and before the end of the demonstration.

5. What will you no when you leave high school (in five years)?

   Interpretation: Effect of satellite TV on future plans.

6. What do you expect the local school to be like in five years? (Multiple choices will be provided by asking the question open-end fashion in a pre-test.)

   Interpretation: Effect of satellite TV on expectations.

7. What would you do if you found out students in (name the nearest city) were studying movie making, and you wanted to study it too? (This question must be modified for teachers in Appalachia.) Rank: Nothing because it probably wouldn't do any good, circulate a petition and give it to the principal although it probably wouldn't do any good, get a teacher to help because that might work, etc.

   Interpretation: If satellite TV has succeeded in showing that it is possible to get needed materials from the outside, there should be less "nothing" answers inside and during the demonstration.

For the audience especially, additional questions will be derived from content analysis of the programming.

Questionnaire for Teachers in Satellite TV-Served Classrooms and Control

1. If you learned that students in (name the nearest city) were studying movie-making (for example), and you were sure your students would

enjoy and benefit from it, what would you do? Nothing because it wouldn't do any good, contact the PTA, contact the principal, alternatives discovered by asking the question open-end in pre-test.

Interpretation: If satellite TV succeeded in providing needed material from the outside, and in convincing teachers they had the power and responsibility to provide materials from the outside, then answers to the above should be more "activist" inside the demonstration than in the control group.

2. What % of outside reading do you choose yourself?

Interpretation: If satellite TV produces dependency on the outside, and the feeling that central control is over-powering, answers to this question should be lower inside and before the end of the demonstration. On the other hand, if satellite TV stimulates teacher initiative, they should be higher inside and before the end of the demonstration.

3. If you were asked by the Board of Education to do something you thought was a bad idea, what would you do? (This question will be made specific and multiple-choice by talking to teachers in the Rockies and Alaska.)

Interpretation: If satellite TV stimulates teacher initiative, then answers to this question should be more "activist" inside and before the end of the demonstration.

Questionnaire for Communities (PTA's and Analogous Groups) in Satellite TV-Served Rural Communities and Control

1. Perceptions of Local School: Where do you feel your children would get the best education, here or in (name the nearest city)? Much better here, a little better here, a little better in the city, much better in the city.

   Interpretation: If satellite TV provided services needed in isolated areas, then more people should answer "better here" within and before the end of the demonstration.

2. In the last couple of years have schools become more or less concerned with practical needs of local children?

   Interpretation: If satellite TV provided services needed in isolated areas, then more people should answer "more" within the demonstration.

3. At which stage in your children's education are schools most responsive to children's practical needs? Rank: Kindergarten, grades 1-3, grades 3-6, Junior High, Senior High.

   Interpretation: If satellite TV in Junior High Schools in the Rockies have provided services needed in isolated areas, then more people should answer "Junior High" within and before the end of the demonstration.

4. What would you do if you found out the schools were teaching something offensive? Rank: Nothing because it wouldn't do any good, contact neighbors, contact PTA, contact individual teachers, contact State Board of Education, contact your Congressman.

   Interpretation: If satellite TV has convinced people that education can be responsive to local needs, then there should be less "nothing," and more "activist" answers within and during the demonstration. If, however, satellite TV has convinced people that education is controlled by central, inaccessible forces, then the inverse should be true.

Perceptions of the Role of Television

1. TV is of particular use in: Rank: Advertising, in-class instruction, at home instruction, linking remote areas, etc.

   Interpretation: Differences between the way people inside and outside the demonstration answer this question will tell us what service they perceived satellite TV as providing. Note that we are not asking about satellite TV, but about TV in general. Contact with satellite TV should change ideas about what TV in general is good for.

2. TV is of particular use in gaining access to high quality educational programming which is: Rank: locally produced, produced at the state level, produced at the national level.

   Interpretation: Differences between the way people inside and outside the demonstration answer this question will tell us the perceived source of satellite TV programming.

3. How much local tax money would you be willing to spend on: In-class television Junior High School instruction, linking remote areas.

   Interpretation: Here we will use with multiple choices the different perceptions people have of the service provided by satellite TV during the demonstration. This will help predict local support available for future operations.

4. How much local tax money would you be willing to spend on: In-class television instruction in grammar schools, in-class instruction in High Schools, etc.

   Interpretation: Here we will use as multiple choices the different perceptions people have of alternative uses of satellite TV not provided in the demonstration. This will help predict local support available for future operations.

General

1. What grade(s) are your children in?
2. What newspapers and magazines do you subscribe to?
3. Do you watch satellite TV programs?
4. Do you have a TV in your house?

B. DEMAND/MARKET ANALYSIS

Demand is seen as consisting of two elements:

1. The price that local educational institutions would actually pay for products the satellite system and/or competitive systems could deliver;
2. Investment the private sector is willing to make in related technology, on the assumption that the major investment in the satellite link per se has already been made.

1. Local Education Institutional Demand for Satellite TV Services:

Assessment of local demand consists of answering two questions:

1. What services do local communities in the demonstration see satellite TV as delivering?
2. How much can we expect local communities to contribute to satellite TV based upon the value they see the delivered services as having?

We will answer the two questions only in the Rockies, where the local schools and communities have direct contact with TV, and conventional survey techniques can be used. Then we will repeat the analysis for regional and national samples which we will describe later. We will concern ourselves, not with whole communities, but only with the people who care about and influence education. Where there is a PTA, we will use the PTA. Where there is no PTA, we will try to find an analogous group. ESCD communities with PTAs are listed in the appendices (See Appendix C).

Question 1: What services do local communities in the demonstration see satellite TV as delivering?

In marketing parlance, answering questions like the above is known as product definition. Our product definition has its genesis in the PTA questionnaire described in the previous section. First, without mentioning satellite TV, we will ask small samples of PTA members within and outside the demonstration to give answers to the following:

1. TV is of particular use in: (Answers might be advertising, in-class instruction, linking remote areas, etc.)
2. TV is of particular use in gaining access to high quality programming which is: (Answers might be locally produced, produced at the state level, produced at the national level, etc.)

The above sample answers are only illustrative. The point is, we will find out the alternative services different people see telelvision as providing.

Then, still without mentioning satellite TV, we will ask the same questions in multiple choice fashion of the total samples described on page A-2 of the previous section.

1. TV is of particular use in: Rank: Advertising, in-class instruction, at home instruction, linking remote areas, etc. (These are only sample answers.)
   Interpretation: Differences between the way people inside and outside the demonstration answer this question will tell us what service they perceived satellite TV as providing. Note that we are not asking about satellite TV, but about TV in general. Contact with satellite TV should change ideas about what TV in general is good for.
2. TV is of particular use in gaining access to high quality educational programming which is: Rank: locally produced, produced at the state level, produced at the national level.

> Interpretation: Differences between the way people inside and outside the demonstration answer this question will tell us the preceived source of satellite TV programming.

The product which satellite TV represents to PTAs inside ESCD in the rural Rockies =

> What people inside the demonstration think television in general is good for
>
> minus
>
> What people outside the demonstration think television in general is good for.

This method of finding out people's perceptions of the product is powerful because it isolates differences caused by contact with satellite TV without people telling you what they think you want to hear about satellite TV.

Our product definition may generate more than one product. In particular, it seems probable that satellite TV will be perceived as offering differing sets of services for communities with and without other television access. ESCD communities with and without commercial and public TV are listed in Table 4-1.

Question 2: How much can we expect local communities to contribute to satellite TV based upon the value they see the delivered services as having?

To determine perceived value we will ask PTAs in the Rockies questions of the two types below:

1. How much local tax money would you be willing to spend on: In-class television Junior High School instruction, linking remote areas.
   Interpretation: Here we will use as multiple choices the different perceptions people have of the service provided by satellite TV during the demonstration. This will help predict local support available for future operations.
2. How much local tax money would you be willing to spend on: In-class television instruction in grammar schools, in-class instruction in High Schools, etc.
   Interpretation: Here we will use as multiple choices the different perceptions people have of alternative uses of satellite TV not provided in the demonstration. This will help predict local support available for future operations.

So far we have operated on the assumption that the PTAs are accustomed to allocating funds for educational resources, and that they can comfortably assign monetary values to satellite TV services. The assumption is based on the recognition that in most rural communities the school budget comprises the major portion of the total investment of the minicipality, and the PTAs generally include most of current, prior and future school board members.

In the event that the above assumption is wrong, we will use the following strategy:

1. Find out how much local communities spend for various educationally related services;
2. Ask questions which compare the value of satellite TV services with services they already pay for. For example:
   - -Which is worth a greater portion of community funds, in-class TV instruction, or 100 new books for the library?
   - -Which is worth a greater portion of community funds, a three-day field trip to Denver, or in-class TV instruction?

Perceived value then becomes the amount of money spent by the community on services satellite TV is seen approximately equal in value to.

The output of the perceived value determination will be a list of products, or perceptions about the services satellite TV can offer, and a list of amounts of local tax money PTAs and Boards of Education would be willing to allocate for the products.

National and Regional Samples

After we have answered question #1 (product definition) and question #2 (price determination) inside ESCD, we will take the "shopping list" outside the demonstration to find out how much other communities would pay for similar services. We will choose regional and national rural samples of PTAs, and possibly an urban sample. Urban samples are appropriate for testing products for people who share informational needs but do not happen to live together in the same region (occupational groups, or people suffering from similar handicaps).

2. Investment The Private Sector is Willing To Make in Satellite TV Related Technology

Potential supporters of satellite communications in the private sector are: the satellite and broadcast industries, potential builders of low-cost receivers for satellite TV, and developers and distributors of educational and television programs.

Via questionnaire/interview, we will find out how much private investment might be generated by the community interest and funding demonstrated by our product definitions and value determination. Precisely whom we will interview is difficult to say. Definition of a sample will evolve out of our contact with the demonstration. It is clear that we should interview potential mass producers of low-cost satellite TV antennas, and distributers of educational and television programs (in particular Encyclopedia Brittanica, and Great Plains Library which have already participated to one degree or another, in ESCD).

Our rationale for concentrating on potential mass producers of low-cost satellite TV antennas is the following:

The real technological innovation as far as education is concerned is the low-cost ground station, not the satellite. Just as the ability to transmit commercial TV point-to-point meant little except as it prompted private sector development in home receivers, so the most important aspect of ESCD is its input to the potential sellers and buyers of ground stations. (Remember the hocus-pocus about "in-theatre" TV in the early years of commercial broadcasts?)

Perhaps the retrospective analogy is: The only institutions that were changed by the first very expensive receivers were the local bars which became impromptu theatres. Sensing the audience response to that service (rather than the limited and restricted demand of the few affluent families) the private sector managed to achieve "impossible" reduction in receiver costs.

It may well be that the rural schools are the analogs to the local bars - to enjoy a brief resurgence through this technology - but doomed to be dramatically changed by the further availability of the technology. In short, in its extreme case, the ESCD is the beginning of the trend to in-home centralized, automatically controlled "programmed" education. Even the remote possibility of this - that the ESCD promises to finally allow several of the promising educational technologies to come together to entirely "de-institutionalize" the school - is sufficient to warrant indepth explanation.

TABLE IV-1

AVAILABLE MEDIA AND COMMUNICATION SYSTEMS AT ESCD SITES

✓ = within signal reception range

(✓) = station on site

in process = cable in process of being installed

--- = information incomplete

ITE	POPULATION	NATIONAL PUBLIC RADIO	COMMERCIAL RADIO	COMMERCIAL TV	PUBLIC BRDCASTING	CABLE TV	TELEPHONE LINES
ederation of Rocky ountain States							
RIZONA							
uba City	500		✓				✓
ayden	1283	✓	✓	✓	✓		✓
cNary	1608		✓				✓
ila Bend	1795	✓	✓	✓	✓		✓
redonia	798		✓				✓
t. Johns	1320		✓				✓
eligman	900		✓		✓	in-process	✓
OLORADO							
onte Vista	3909		(✓)		✓	33%	✓
eeker	1597		✓				✓
ontrose	6496		(✓)	(✓)	✓	56%	✓
ntonito	1013		✓				✓
ollbran	225	---	---	---	---	---	✓
aturita	820		✓				✓
raig	4205		(✓)			in-process	✓
DAHO							
hallis	784		✓	✓			✓
cCall	1758		(✓)	✓			✓
apwai	400	---	---	---	---	---	✓
t. Maries	2571		✓	✓	✓	17%	✓
almon	2910		(✓)	✓		in-process	✓
allivue		---	---	---	---	---	
sburn	2248		✓	✓	✓	87%	✓
ONTANA							
usky		---	---	---	---	---	✓
olstrip		---	---	---	---	---	✓
t. Benton	1863		✓	✓			✓
oundup	2116		✓	✓			✓
hree Forks	1188		✓	✓			✓
hitehall	1035		(✓)	✓			✓
. Yellowstone	756						

TABLE IV-I (continued)

SITE	POPULATION	NATIONAL PUBLIC RADIO	COMMERCIAL RADIO	COMMERCIAL TV	PUBLIC BRDCASTING	CABLE TV	TELEPHONE LINES
Rocky Mountain con't							
NEVADA							
Owyhee	100		✓				✓
McDermitt	100		✓				✓
Corlin	1313		✓				✓
Winnemucca	3587		(✓)	✓			✓
Ely	4176		(✓)			in-process	✓
Elko	7621		(✓)	(✓)	✓	90%	✓
Battle Mountain	1856		✓	✓			✓
NEW MEXICO							
Penasco	627		✓				✓
Cuba	900		✓				✓
Dulce	500		✓		✓	52%	✓
Springer	1574		✓		✓	55%	✓
Wagon Mound	630		✓				✓
Questa	1095		✓				✓
Mara	310		✓	✓			✓
UTAH							
Blanding	2250		(✓)				✓
Enterprise	844		✓				✓
Heber	3245	✓	✓	✓	✓		✓
Kanab	1381		✓				✓
Margan	1586	✓	✓	✓	✓		✓
Panquitch	1318		✓				✓
Hyrum	2340		✓				✓
WYOMING							
Saratoga	1181		✓	✓			✓
Pinedale	948		✓				✓
Riverton	7995		(✓)	(✓)		91%	✓
Arapahoe	---	---	---	---	---	---	✓
Dubois	898		✓			in-process	✓
Lovell	2371		✓			in-process	✓
Sundance	1056		✓	✓			✓

TABLE IV-1 (Continued)

TE	POPULATION	NATIONAL PUBLIC RADIO	COMMERCIAL RADIO	COMMERCIAL TV	PUBLIC BRDCASTING STATION	CABLE TV
SA's - palachian Regional mmission						
ean, NY	19,169		(✓)	✓	✓	95%
edonia, NY	10,326	✓	✓	✓		in-process
inborro, PA	4,871	✓	✓	✓	✓	71%
follette, Tenn.	6,902		(✓)	✓	✓	53%
almont, Tenn.	518	---	---	---	---	---
hnson City, Tenn.	33,770		(✓)	(✓)	✓	53%
rton, VA	4,001		(✓)	(✓)	✓	85%
icklyville, VA	---	---	---	---	---	---
one, NC	8,754		(✓)	✓	✓	64%
mberland, MD	29,724		(✓)	✓	✓	90%
Henry, MD	---	---	---	---	---	---
yser, WVA	6,586		(✓)		✓	82%
ntsville, ALA	137,802		(✓)	✓	✓	43%
ntersville, ALA	6,491		(✓)	✓	✓	78%
insville, ALA	2,099		(✓)	✓	✓	

TABLE IV-1 (Continued)

SITE	POPULATION	NATIONAL PUBLIC RADIO	COMMERCIAL RADIO	COMMERCIAL TV	PUBLIC BRDCASTING STATION	CABLE TV	TELEPH LINK
Allakaket	174		✓				
Angoon	395		✓				✓
Aniak	205		✓				
Craig	273		✓				
Fairbanks	18,311	✓	(✓)	(✓)	✓		✓
Galena	302		✓				✓
Juneau	6,797		✓	(✓)		25%	✓
McGrath	241		✓				✓
Minto	161	✓	✓	✓			
Nenana	362	✓	✓	✓			✓
Nikolai	112		✓				
Petersburg	2,042		✓			in-process	✓
Russian Missions	146		✓				
Sleetemute	122		✓				
Tanana	349		✓				✓
Valdez	1,052		✓			in-process	✓
Yakutat	230		✓				

SITES OF SPECIAL INTEREST: Without Commercial Television

Federation of Rocky Mountain States

ARIZONA

Tuba City
McNary
Fredonia
St. Johns
Seligman

COLORADO

Monte Vista
Meeker
Montrose (✓)
Antonito
Collbran ---
Naturita
Craig

IDAHO

Lapwai ---
Vallivue ---

MONTANA

Busby ---
Colstrip ---
W. Yellowstone

NEVADA

Owyhee
McDermitt
Corlin
Ely
Elko (✓)

NEW MEXICO

Penasco
Cuba
Dulce
Springer
Wagon Mound
Questa

Rocky Mountain con't

UTAH

Blanding
Enterprise
Kanab
Panquitch
Hyrum

WYOMING

Pinedale
Riverton (✓)
Arapahoe ---
Dubois
Lovell

RESA's - Appalachian Regional Commission

Coalmont, Tenn. ---
Johnson City, Tenn. (✓)
Narton, VA (✓)
Sticklyville, VA ---
McHenry, MD ---
Keyser, WVA

ALASKA

Allakaket
Angoon
Aniak
Craig
Fairbanks (✓)
Galena
Juneau (✓)
McGrath
Nikolai
Petersburg
Russian Missions
Sleetmute
Tanana
Valdez

C. LINGUISTIC ANALYSIS

The question we propose to answer with linguistic analysis is:

What position does satellite TV occupy in the belief structure of Alaskan rural sub-cultures? Do rural Alaskans look upon satellite TV as an instrusive force from the outside which they have no control over, or do they see it as a tool they can control to their own benefit?

We see linguistic analysis as an unobstrusive substitute for questionnaire/interviews of rural Alaskans. Linguistic analysis is in many ways superior to questionnaires, but too elaborate for use throughout the demonstration. (If we found out that questionnaires were inappropriate on Indian reservations in the Rockies, we might use linguistic analysis there too.)

Linguistic analysis has been used in Spanish, English, Uacatec, Nahuatl, Tzetal (Mexican Indian Languages), Quechua (Peruvian Indian Language), to perform tasks which dwarf this task in complexity and difficulty. In Peru, linguistic analysis was used to define the place in belief structures occupied by Peace Corps Volunteers.*

Possible sources of linguistic data in Alaska are:

1. Local media (newsletter or whatever) discussions of the satellite, TV, education, technology, etc.

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* Stefflre, Volney, and Wendell, Marlys, "A Study of the Perceptions of Peace Corps Workers and Their Activities by Spanish and Quechua Speakers in Chimbote and Cuzco, Peru."

2. We will supplement this data by hiring linguistic informants who come to Anchorage for one reason or another from satellite TV - served communities such as: members of Consumer Committees, new high school students.

3. Essays written by students about TV, education, and technology, etc.

For numbers 1 and 3, the analyzed language would be English. For number 2, it would be native languages and/or English.

Linguistic analysis depends on the following logic: Statistical analysis of what people say about things when they are not saying why they like or dislike them can tell you why they like or dislike them. The strategy is to collect verbal or written material about satellite TV, and then find the other things that the people talk the same about. The cluster of objects, events, etc., that satellite TV is talked the same about as, will tell you what people really believe, think, and feel about it. And it will tell you what position satellite TV occupies in a particular sub-culture's belief structure.*

We will perform the analysis for at least one Athabaskan and one Eskimo community. It will require about one professional month plus one week of help from a local social scientist acquainted with Alaskan native communities and their languages.* The specific procedures will depend on the data at hand (Type of informants available). The general procedure is as follows:

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* Stefflre, Volney, "Stimulation of People's Behavior toward New Objects and Events," The American Behavioral Scientist, May 1965, pp. 5-12

1. Find the words used to describe TV (What do you call it? How do you describe it?).

2. Find the sentences that the words occur in. It is impossible to find all possible sentences, and fifty per word is more than sufficient. "Utterance" is a better word than sentence, because we are not interested in "complete sentences," but in ways the satellite TV describing words are used.

   In the instance where informants are used, you ask them to form utterances, not that they agree with, but that are grammatical, or make sense, or some other criterion of linguistic satisfactoriness which fits. Many languages do not have a concept which corresponds precisely to our notion of grammaticalness, but they all have notions of appropriateness which are separate from agreement. We are interested in: "It is correct Athabaskan to say that about satellite TV." We are not interested in: "I agree with that sentence."

3. Remove words referring to satellite TV from the sentences, and then find out what other words fit into the same frames. Some words will fit into some frames, and some will fit into others. Probably none will fit into all frames unless they mean "satellite TV," and were missing from the original list.

---

* Dr. Michael Krause of the Alaska Native Language Center is a possible candidate.

4. Form a similarity matrix comparing the distributions of words describing satellite TV to other words that can be used in the same frames. The words in the matrix below are meant to show how the matrix works, and do not correspond to anyone's expectations about what would happen.

	Men enjoy	Women enjoy	Children enjoy	Men learn from	Women learn from	Children learn from	Are useful	Is a good place to talk	I go to because I have to	Is square	Helps the community	One frequents	One visits	One has to go to	One watches	One talks to Anchorage with	Belongs to white men
Satellite TV																	
Outboard Motors																	
School																	
Teacher																	
Bar																	
Radio																	
Hammer																	
Doctor																	
Magic																	
Land Claims Act																	
Telephone																	

Data collection is completed when all cells are filled with 1's and 0's.

It does not make much difference which frames of all possible frames we use, as long as we have fifty or so. We are not interested in the meanings of the frames, although it may be interesting to study them as a separate operation.

5. Compute a measure of distributional similarity comparing every word describing satellite TV to all the other words that fit to one degree or another in the same linguistic frames.

$$\text{Distributional similarity} = \frac{\text{As matched by Bs} + \text{Bs matched by As}}{\text{As} + \text{Bs}}.$$

A = A word used to describe satellite TV.
B = A word used to describe something other than satellite TV.

6. Study the objects and events referred to by the words that have a high distributional similarity to the word(s) that refer to satellite TV. Are the objects and events, in general, intrusive forces from the outside, or tools that rural Alaskans can control to their own benefit? We now have the answer to:

What position does satellite TV occupy in the belief structure of Alaskan rural sub-cultures?

The sample size required is small. Three or four people per community, or type of community is enough.* If paid informants prove not to be feasible, then we will perform operations similar to those above on student essays, and local media reports about satellite TV, and we would probably work only in English.

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* Stefflre, Volney, Reich, Peter, and Wendell, Marlys. "Some Eliciting and Computational Procedures for Descriptive Semantics." (NSA Grant GS 688)

SECTION V

IMPACT OF SATELLITE TV ON INSTITUTIONS AND BEHAVIOR TOWARD THEM: UNOBSTRUSIVE MEASUREMENTS

The unobstrusive measures we will use to assess impact of satellite TV on institutions are for the most part records which are compiled as a matter of course by educational and other institutions. There are two ways to classify the measures: By topic and by probable data source. The measures are listed both ways in this section. Below are the topic headings. For a discussion of how unobstrusive measurements relate to interfaces between institutions, and between institutions and their constituents, see the end of this section.(Page V-14)

1. Demand for satellite TV services: Attendance, requests for services, and other participation in free-choice situations.

2. Innovation: Does satellite TV merely take the place of traditional information inputs, or does it stimulate new ones by suggestion, need for complement, competition? What new interests are generated by the programming? To whom does the innovation diffuse?

3. Autonomy: Does satellite TV stimulate initiative on the part of local teachers and schools? Or does satellite TV give central authority a foot in the door? And does it start or reinforce dependency and a "let George do it" approach to solving educational problems?

4. Competition (John Henry type): If satellite TV really offers a service, it may represent a threat to some interest somewhere, and some institution will react to get its share of the market back or compete with satellite TV for the new market opened up. If satellite TV offers no service that people need, then it is no threat to anyone, and it proceeds uncontested.

5. Prestige: Does contact with high technology and large federal programs enhance the prestige of participating institutions? Do people appear to act on the theory: "If the big shots in Washington think this much of our school, then it must be pretty good?"

6. Cross-fertilization: Does satellite TV create common interests, make people aware of common interests, show institutions the advantage of facilities sharing? Or is it just a sterile, technological sharing arrangement with no substance?

At present there are 60 unobstrusive measures, a number which will decrease as we find out what is easy, possible, difficult to collect, etc. Later in this section the measures are listed by probable data source. Some measures are substitutes for each other, and which is chosen will depend on which is most readily available.

CLASSIFICATION OF UNOBSTRUSIVE MEASUREMENTS BY TOPIC

Demand for satellite TV services (Refer to page V-1 to see what we mean by "demand" here):

-Alaskan Native Magazine attendance over time.

-Choice of language channel in Alaska over time.

-Teacher training attendance in Appalachia over time.

-Number and type of programming requests over time for the Alaska Native Magazine.

-Number and type of programming requests over time for the Rockies Materials Distribution Service.

-Number and type of programming requests over time for the University of Kentucky Information Center.

-Open sites attendance in the Rockies.

-Who tries to get in and out of the demonstration in all three regions.

Innovation (Refer to page V-1 to see what we mean by "innovation" here):

-Biographical data on joiners and leavers over time for the Alaskan Consumer Committees.

-Biographical data on joiners and leavers over time for the Rockies Utilization staff.

-Biographical data on joiners and leavers over time for the University of Kentucky satellite TV participants.

-Biographical data on joiners and leavers over time for the ARC satellite TV participants.

(Interpretation of the above four items: What kinds of new people participate in education due to satellite TV?)

R:* # of courses offered x school over time.
R: Variety of courses offered x school over time.
AR: Background of teachers hired x school over time.
AR: #, type new text books adopted x school over time.
AR: % text books x topic x school over time.
AR: # books acquired by school library x topic x school over time.
AR: % books acquired by school library x topic x school over time.
AR: Student-designed courses and other innovations x school over time.
AR: Locally designed courses, programs x school over time.
AR: #, type field trips x school over time.
AR: #, type school clubs, etc., x school over time.
AR: #, type books acquired, magazines, newspapers subscribed to x community over time.
AR: Criteria for hiring teachers.
AR: #, type of outside experts brought into the classroom.

Autonomy (Refer to page V-1 to see what we mean by "autonomy" here):

R: # centrally required courses x school over time.
R: # centrally designed courses x school over time.
AR: # of regulations sent down x school over time.
AR: # of reports received x school over time.
AR: # and type of requests by school over time.
AR: # centrally required textbooks x school over time.
AR: # centrally provided textbooks x school over time.
AR: # centrally required films, etc., x school over time.

---

*R = Rockies; A = Alaska; Ap = Appalachia.

(Ap appears relatively seldom because Appalachian communities and schools do not have direct contact with satellite TV).

AR: # centrally provided films, etc., x school over time.

AR: PTA or Alaskan Native Association meeting and action agendas x community over time.

AR: Community involvement incourse choice, extra-curricular activities, outside experts, book acquisition, hiring policy, adult courses, innovative courses.

Cross-fertilization (Refer to page V-1 to see what we mean by "cross-fertilization"):

AR: #, type exchanges, competitions, visits x school over time.

AR: Communities that exchange, compete, visit with each other.

ARAp: Official correspondence with other institutions.

ARAp: Non-TV facilities shared.

ARAp: Institutions and communities with whom they share.

AR: Cooperation between PTAs in different towns over time.

Prestige (Refer to page V-1 to see what we mean by "prestige"):

AR: # of people running for the school board x town over time.

AR: Type (occupation, ethnic) PTA or Alaska Native Association members x community over time.

AR: # teachers in what type activities, commissions, etc.

Competition (Refer to page V-1 to see what we mean by "competition"):

ARAp: Changes in communications plans.

ARAp: PBS local/regional/national program ratios.

ARAp: Programs started to compete with satellite TV services.

ARAp: Programs improved to compete with satellite TV services.

ARAp: How much money, time, effort, opportunity are expended to replace each use of satellite TV? (See cost analysis section. This measurement is really a series of complex measurements.)

B.UNOBSTRUSIVE MEASUREMENTS CLASSIFIED BY DATA SOURCES

Our approach specifies measures of change that do not require continual monitoring during the demonstration, but only verification that they are being compiled. Actual collection and analysis will not begin until after the demonstration ends and will continue for one year.

There are seven categories of data sources (see below). The number in parenthesis following each category is the number of measures in the category. In general, those data sources at the top of the list are more convenient than those at the bottom because there are less of them. For example, there are only three satellite TV coordinating offices (category #1), but 88 communities we would have to contact to collect data from category #5.

1. Regional satellite TV coordinating offices or local evaluators are collecting it. (6)
2. We encourage regional satellite TV coordinating offices or local evaluators to collect it if they are not already doing so. (6)
3. Central state offices probably collect it. (18)
4. Central state offices may collect it. (4)
5. Community offices probably collect it. (4)
6. Community offices may collect it. (5)
7. We propose to collect it ourselves. (2)

In all there are at present sixty measures which you will find in the next section. This number will decrease as we find out what is possible, easy, difficult, etc. Remember that each measure belongs also to a topic category listed earlier in this section.

Regional Satellite TV Coordinating Offices or Local Evaluators are Collecting:

Attendance over time during demonstration in free-choice situations:
- Alaskan Native Magazine
- Choice of language channel in Alaska for all programs
- Teacher training attendance in Appalachia

Number and type of programming requests over time:
- Alaska Native Magazine
- Rockies Materials Distribution Service
- University of Kentucky Information Center

We Will Encourage Regional Satellite TV Coordinating Office or Local Evaluators to Collect:

- Open sites attendance in the Rockies
- Who tries to get in and out of demonstration in all three regions
- Biographical data on joiners and leavers over time:
    - Consumer Committees in Alaska
    - Utilization Staff in the Rockies
    - Appalachia Regional Commission satellite TV staff
    - University of Kentucky satellite TV participants

Central State Offices Probably Collect:

Department of Education
*R: # of courses offered x school over time
R: variety of courses offered x school over time

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*R = Rockies, A = Alaska, Ap = Appalachia

R: #centrally required courses x school over time
R: distribution of % students x course type x school over time
AR: # of regulations sent down x school over time
AR: # of reports received x school over time
AR: # and type of requests by school over time
AR: # centrally required textbooks x school over time
AR: # centrally provided textbooks x school over time
AR: # centrally required films etc. x school over time
AR: # centrally provided films etc. x school over time
AR: background of teachers hired x school over time
AR: # of people running for the school board x town over time

Department of Telecommunications
ARAp: Changes in regional communications plans
AR: PBS local/regional/national program ratios

Central State Offices May Collect:

Department of Education
AR: #, type of textbooks x topic x school over time
AR: % textbooks x topic x school over time
AR: # books acquired by school library x school over time
AR: % books acquired by school library x topic x school over time
AR: student-designed courses-other innovations x school over time
AR: Locally designed courses, programs x school over time
AR: #, type field trips x school over time
AR: #, type exchanges, competitions, visits x school over time
AR: communities that exchange, compete, visit each other over time
AR: #, type school clubs, etc. x school over time

PTA Headquarters
AR: # PTA members x school over time
AR: type (occupation, ethnic) PTA members x school over time
AR: PTA meeting and action agendas x school over time
AR: cooperation between PTAs in different towns over time

Community-Library Headquarters

AR: #, type books acquired, magazines, newspapers subscribed to x community over time

AR: #, type books, magazines, newspapers checked out x community over time

Department of Telecommunications

AR: local communications plans

Community Offices Probably Collect:

School Principal's Office

AR: criteria for hiring teachers

ARAp: official correspondence with other institutions

ARAp: non-TV facilities shared

ARAp: institutions and communities with whom they share

Community Offices May Collect:

School Principal's Office

AR: #, type outside experts brought into classroom

AR: # teachers in what type of community activities

AR: Community involvement in course choice, extra-curricular activities, outside experts, book acquisition, hiring policy, adult courses, innovative courses

We Propose to Collect Ourselves (after the demonstration):

ARAp: how much money, time, effort, opportunity are expended to replace each use of satellite TV?

ARAp: programs up-graded to compete with satellite TV services

ARAp: programs started to compete with satellite TV services

C. ANALYSIS OF UNOBSTRUSIVE MEASUREMENTS (IMPACT ON INSTITUTIONS)

Analysis of Unobstrusive Measurements

We will collect unobstrusive measurements of impact of satellite TV on educational institutions during the demonstration, and for the year following it. For explanation purposes, we will refer to only three points in time: Beginning of demonstration (June 1974), end of demonstration (June 1975), and one year after the demonstration (June 1976). Following are:

1. A graphic representation of possible data outcomes and their implications for satellite TV, and
2. A statistical representation of possible data outcomes and their implications for satellite TV.

Graphic Analysis

The unobstrusive measurement we will talk about for explanation purposes here is: Average # of books checked out of school libraries in schools served by satellite TV in the Rockies. We will work always with the difference between schools in the demonstration and schools in a control group.

d_1 = The difference between the demonstration school average and the control school average for the year June 1973 - June 1974. (The year before the demonstration.)

d_2 = The difference between the demonstration school average and the control school average for the year June 1974 - June 1975. (The year of the demonstration.)

d_3 = The difference between the demonstration school average and the control school average for the year June 1975 - June 1976. (The year after the demonstration.)

For simplicity's sake we will assume here that $d_1 = 0$, although that is not necessary to our approach.

GRAPHIC ANALYSIS OF UNOBSTRUSIVE DATA

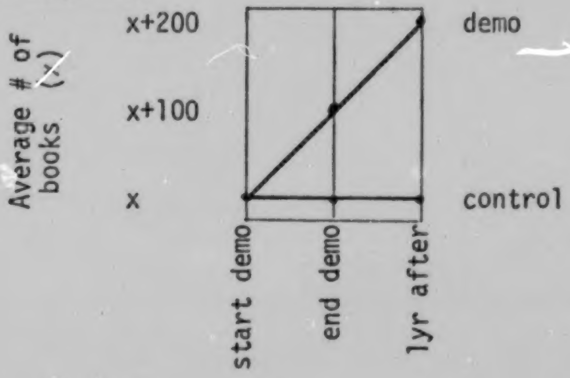
DATA

INTERPRETATION

(d = demo-control)

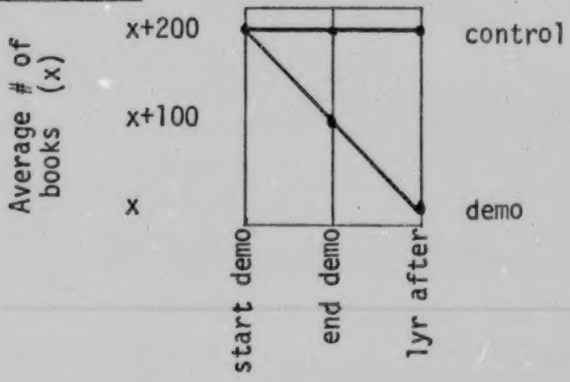
d_1 d_2 d_3

Situation #1



Very positive reflection on satellite TV. Apparently it has stimulated interest in books whic sustains itself after satellite TV has left.

Situation #2



Very negative reflection on satellite TV. Apparently it has taken the place of some books, an interest in those books does not return after satellite TV leaves.

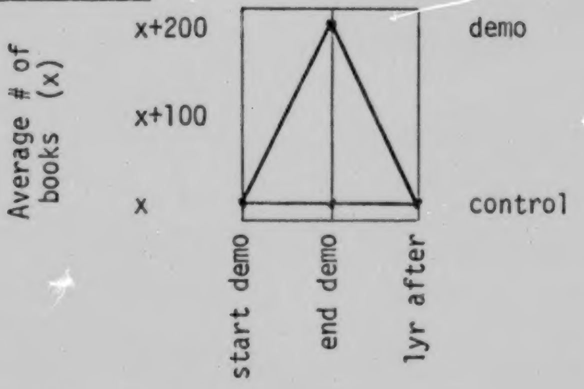
DATA

INTERPRETATION

(d = demo-control)

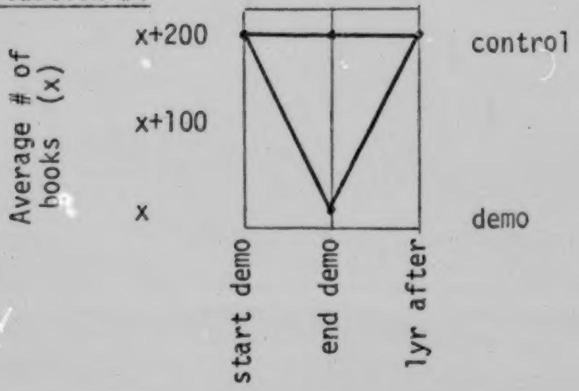
d_1 d_2 d_3

Situation #3



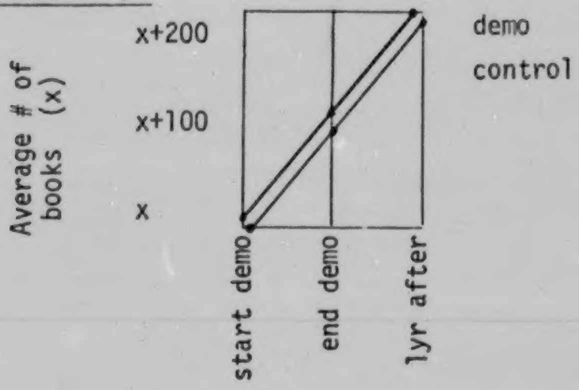
Positive reflection on satellite TV. Apparently it has stimulated interest in books which subsides after satellite TV leaves.

Situation #4



Negative reflection on satellite TV. Apparently it has taken the place of some books, but interest in the books returns after satellite TV leaves.

Situation #5



Neither positive or negative reflection on satellite TV.

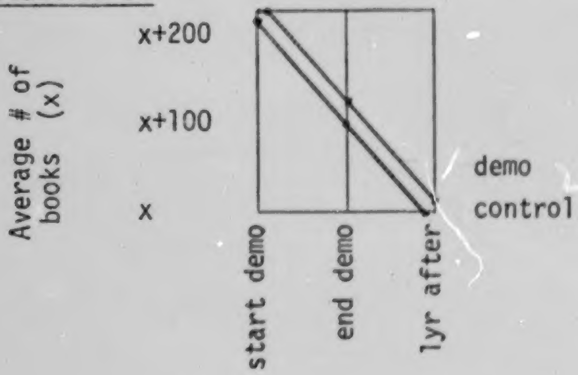
DATA

INTERPRETATION

(d = demo-control)

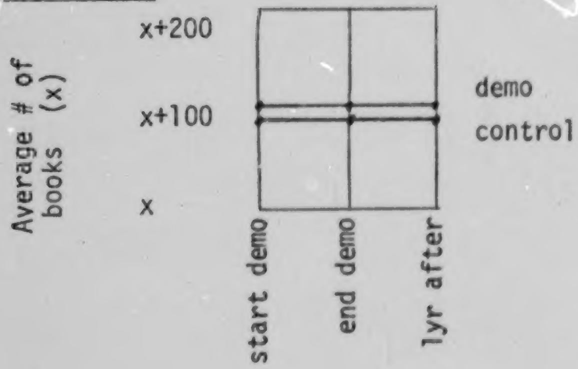
d_1 d_2 d_3

Situation #6



Neither positive or negative reflection on satellite TV.

Situation #7



Neither positive or negative reflection on satellite TV.

The above does not exhaust all possibilities, however the spectrum of possibilities is covered fairly well.

STATISTICAL ANALYSIS OF UNOBSTRUSIVE MEASUREMENTS

The statistical situations which correspond to the graphic representations and interpretations on the previous pages are:

Situation #1

$$F = \frac{d_2 - d_1}{\sigma_{(d_2 - d_1)}} \quad \text{and} \quad F = \frac{d_3 - d_2}{\sigma_{(d_3 - d_2)}}$$

Positively significant (.05)

Situation #2

$$F = \frac{d_2 - d_1}{\sigma_{(d_2 - d_1)}} \quad \text{and} \quad F = \frac{d_3 - d_2}{\sigma_{(d_3 - d_2)}}$$

Negatively significant.

Situation #3

$$F = \frac{d_2 - d_1}{\sigma_{(d_2 - d_1)}}$$

Positively significant.

$$F = \frac{d_3 - d_2}{\sigma_{(d_3 - d_2)}}$$

Negatively significant.

Situation #4

$$F = \frac{d_2 - d_1}{\sigma_{(d_2 - d_1)}}$$

Negatively significant.

$$F = \frac{d_3 - d_2}{\sigma_{(d_3 - d_2)}}$$

Positively significant.

Situations 5, 6, and 7

Neither $(d_2 - d_1)$, nor $(d_3 - d_2)$ significant.

Heterogeneity - homogeneity

It is also possible to measure the impact of satellite TV on the heterogeneity of a variable like library book usage:

1. When there's an increase in something, library book usage say, does the variety increase (heterogeneity), or is it only more of the same?

2. When overall library book usage stays the same, does the variety increase?

3. When there's a decrease, is it overall loss of interest in library books, or loss in interest in certain areas?

Mathematically we'll use a measure of variance which takes advantage of the fact that: The product of disparate fractions (homogeneity) is smaller than the mean of the fractions multiplied by itself (heterogeneity). .5 x .5 = .25, but .1 x .9 = .09.

Units of Analysis: Institutional Interfaces

The real units of analysis for measurement of the impact of satellite TV on educational institutions are not the individual unobtrusive measurements just described, but rather clusters of unobtrusive measurements that characterize a particular institutional interface. By "interface" we mean a relationship between educational institutions, or between educational institutions and the people they serve.

If we find that during the ESCD one school begins requesting more films from the Department of Education, that is not grounds for concluding that satellite TV has altered the interface between local schools and the Department of Education. If, however, we find that all schools within the demonstration begin requesting more films, but the schools outside the demonstration do not, then we begin suspecting something. A real interface change has occurred when, not only film requests increase, but also requests for permission to design new courses, requests for new textbooks, and maybe complaints about Department of Education regulations also increase.

SECTION VI

CALIBRATION OF THE USE THAT IS MADE OF SATELLITE TV: CONTENT ANALYSIS OF THE PROGRAMMING

During the past several months we have considered several methods for systematic, computer-aided analysis of satellite TV programming. Our purpose was to answer the following types of questions:

1. What features of the institutions intervening between the satellite and the users are reflected in the message transmitted?

2. How do the intervening institutions (grantees and programmers) perceive the power relations between themselves and the people and institutions they serve? Do they convey the message that they are amenable to local school control?

3. Does the image that the grantee institution has of itself (about power relations for example) seem to change over time due to feedback from the users?

4. What features of satellite TV technology are reflected in the message transmitted?

5. What features of the decisions and events which led to the ESCD are reflected in the message transmitted? What is the image of the government that is transmitted?

6. What types of impact on the attitudes and beliefs of the audience should we look for? (To understand how #6 fits into our impact assessment, see Section IV A)

We have carefully considered, and eliminated, procedures of analysis which depend solely on: word counts, word categories word contingencies, word orders, word contexts, distributions of words over contexts, and distributional similarity of words over contexts. (For a use to which we will put distributional similarity of words over contexts, see the previous section titled: Measurement of the Impact of Satellite TV on How Educational Institutions and Technology are Perceived: Linguistic Analysis , Section IV-C).

We have decided on a computer-aided approach that depends on agreement among trained, independent viewers about classifying aspects, segments, themes, and characters of programs according to categories determined by the hypotheses to be tested. Such a methodology has been developed by Dr. George Gerbner at the Annenberg School of Communications, University of Pennsylvannia, and it has been used extensively in media analyses similar to the one we propose here. Dr. Gerbner and his research team will be our consultants, and the University of Pennsylvannia will be our sub-contractor for computer service to do the content analysis portion of our evaluation.

A. WHAT IS CONTENT ANALYSIS?

1. Content analysis, as used at the Annenberg School of Communications, is the reliable and objective determination of those patterns in systems of messages that are not amenable to casual or selective observation.

2. In general, content analysis is concerned with common features manifest in message aggregates to which large, heterogeneous groups are exposed. It is not concerned with individual, selective, and differential perceptions, which is the task of impact analysis.

3. However, content analysis is a necessary pre-requisite to adequate analysis of impact. From content analysis performed at the Annenberg School on programs transmitted by ESCD grantees, PCI will derive some hypotheses about affective impact in addition to those already described in the previous section titled: Impact of Satellite TV on How Educational Institutions and Technology are Perceived(., Section IV).

B. HOW HAS CONTENT ANALYSIS BEEN USED IN THE PAST?

Content analysis has been employed whenever large bodies of messages required systematic, reliable and objective investigation. Many of the applications are described in:

- The Analysis of Communication Content. George Gerbner. John Wiley, 1969.
- Content Analysis for the Social Sciences and Humanities. Ole R. Hosti. Addison-Wesley, 1969.
- Communications Technology and Social Policy. George Gerbner, Larry P. Gross, William H. Melody. John Wiley, 1973

During World War II, content analysis was used on diplomatic and non-diplomatic utterances to discern policy intentions. Omission and commission comparisons over time are very powerful in this context. Such analyses were used successfully to predict intentions and actions of Nazi Germany.

Just recently, Dr. Gerbner and the Annenberg School of Communications were awarded funds by NIMH for a three year study of "The Social Reality of Television Drama" which is aimed at matching pervasive trends in

American television with popular conceptions of reality. Their proposal and pilot study are included in the appendices.(Appendix D).

HOW DO YOU DO CONTENT ANALYSIS?

To do content analysis, you need a large body of messages given off by a single source, or by a coherent group of sources. In general, content analysis is used to characterize institutions as opposed to individuals. Messages given off by institutions display regularities because of the constraints placed on members' behavior by institutions. Institutional behavior constraints are compelling, not because they are actively enforced, but because institutions select people who fit available roles, and they reward behavior that corresponds to the roles.

Features of messages measured by content analysis can be classified into the groups below. Both verbal and visual material are analyzed.

- Attention: What is expressed?
- Emphasis: What do they imply is important?
- Tendency: Adjectives and other loadings, as measured by tools such as the Osgood Semantic Differential.
- Structure: What goes logically with what, and what appears together with what in the messages?

Samples of conclusions based on content analysis follow. They are excerpted from the pilot study done for NIMH cited earlier.

> "More than nine out of ten dramatic programs (other than cartoons) are "realistic." The world of television is mostly domestic, urban, and contemporary. Foreigners make up 14 percent of its population. The fantastic and the implausible are more likely to occur far out in the country, or in other countries, than close to home. Wars, small towns, places of great wealth and

poverty, and sparsely populated areas are more likely to be found abroad than in the U.S. "

"The past is rarely and the future is never comic. Poverty is funnier than wealth, even if it is rare (once in a hundred settings) and far away. Most of those employed in the world of television drama are professionals, but most are also unmarried and in the prime of life. Business, government, entertainment, law enforcement, and crime are major occupations. Half of all people commit violence, one fifth perpetrate some crime, six percent kill someone and three percent are killed. "

"'Males outnumber females four to one. Children's cartoons portray even fewer women and more violence. Children and old people are hard to find; each comprise only about six percent of the television population. More females than males are young, but women age earlier and faster than men. The aged are more likely to be evil, and thus to fail, than the more youthful."

" Social power on television is demonstrated in the pattern of violent action. Although in 1972 the violence index was at its 1970 level (slightly below 1971), and the number of violent characterizations declined somewhat, the rate of violent episodes rose and the ratio of victimization was the highest in six years. That ratio, the number of victims for each violent character, might be considered an indication of domination and possibly fear cultivated in the television world. The victimization ratio for the last six years was:

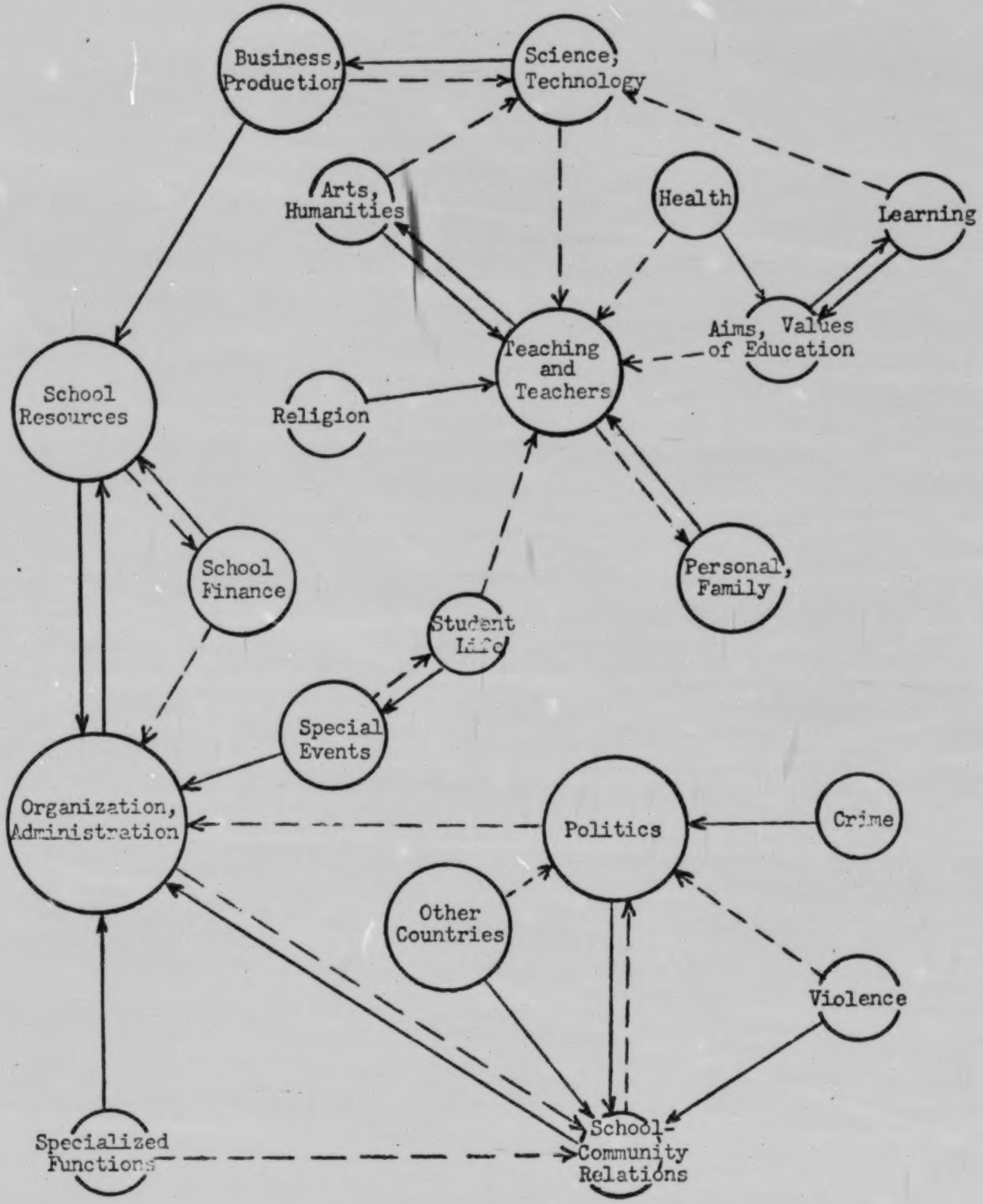
1967	1.16
1968	1.13
1969	1.21
1970	1.09
1971	1.10
1972	1.26

"Thus the absolute amount of violence is not necessarily a good measure of its functions in shaping conceptions of social reality. For example, the victimization ratio for white males was 1.13, for other males 1.18. The same ratio for all males was 1.14, for all females 1.39. "

"The next question is now the social symbolic context of the television world affects the prevailing cultural climate and cultivates viewers' conceptions of the facts of life. That is the question addressed in the cultivation analysis part of the pilot (and the proposed) project. "

Another data presentation, called a corregram, is shown in Figure VI-1. It shows the relationships of topics and themes to each other for a sample of newspaper articles about education.

FIGURE 1: TOPIC GROUP STRUCTURE CORREGRAM; U.S. NEWSPAPER ARTICLES ABOUT EDUCATION


Business, Production
Science; Technology
Arts, Humanities
Health
Learning
Aims, Values of Education
Teaching and Teachers
School Resources
Religion
School Finance
Personal, Family
Student Life
Special Events
Organization, Administration
Politics
Crime
Other Countries
Violence
Specialized Functions
School-Community Relations

Solid lines show the highest correlation for each topic, and broken lines show the second highest correlation.

D. CONTENT ANALYSIS PLAN

The demonstration year will be devoted to data collection and deriving hypotheses, samples and instruments. The year following the demonstration will be devoted to training courses, coding, and analysis. Following are the tasks in sequential order.

1. Start recording all non-canned programs on video-tape. (PCI will handle the taping.)
2. Examine written material about programs.
3. Examine selected transmissions.
4. Develop hypotheses according to the questions presented earlier.
5. Choose samples for testing the hypotheses. We will content analyze 100 hours of programming (maybe including some interactive material). We will divide the 100 hours among three or four of the thirteen programming efforts in the three regions.
6. Develop coding instruments to probe for the features hypothesized about.
7. Hire and train 12 viewer-coders. Training takes 2-3 weeks.
8. Trained viewers code sample transmissions. (Sample coding instruments are included in the appendices.(Appendix D)
9. Pairs of coders eliminate idiosyncratic interpretations via agreement. Pairs are systematically switched to avoid development of "sub-cultures."
10. Throw away message units where there is not unanimity among pairs.
11. Computer-test hypotheses using primarily correlational techniques.
12. Develop hypotheses about impact on individuals. (To understand how these hypotheses get plugged into our impact assessment, see section IV-A.)
13. Test hypotheses about impact on individuals. (PCI, not the Annenberg School of Communications.)

Of the thirteen programming efforts that comprise ESCD (Rockies-4, Appalachia-4, Alaska-5) we will select three or four for content analysis. It is probable that the Alaskan Native Magazine, and the Rockies Jr. High career education course will be two of the three or four programs selected.

The Alaskan Native Magazine appears to be the best example of an interactive program where you might expect changes over time in the message transmitted as a result of contact with the audience. And the Rockies Jr. High career education course appears to be the best example of centralized pre-programming specifically for satellite TV.

SECTION VII

STUDY OF THE DECISIONS AND EVENTS THAT LED TO THE EDUCATIONAL SATELLITE COMMUNICATIONS DEMONSTRATION

Described in this section is a systematic, retrospective analysis of documents for studying the events and decisions that led to ESCD. It will be carried out by Mr. Charles Blaschke of Educational Turnkey Systems. The approach includes independent classification and analysis, by at least two people working separately, of formal and informal documents, and can be thought of as a simple form of the content analysis described in a previous section.

The retrospective document analysis will answer questions of the following types:

1. How do the decisions and events that led to ESCD compare with those that led to other demonstrations which proved to be cost/effective or non-cost/effective? (A cost/effective demonstration is one that generates valuable information, and is not necessarily a demonstration that "works.")

2. Based on #1, what can we predict about the cost/effectiveness, or informativeness, of ESCD?

3. Should NIE subsidy future demonstrations like NIE?

4. What criteria should NIE use to decide which demonstrations to subsidy?

RATIONAL FOR RETROSPECTIVE STUDY OF ESCD DOCUMENTS

Social science research and experimentation is at a crossroad where forces internal as well as external to the profession could determine its future for the remainder of this century. This is particularly true for the status of policy, as opposed to disciplinary, social research and experimentation in education, the responsibility of which now lies under the National Institute of Education, where external forces even now threaten the validity of the NIE experiment. If NIE is to ensure the 'internal validity' of its modus operandi in research and experimentation, greater care and knowledge is needed in the areas of project selection, design, and the manner of implementation. Major problems presently confronting NIE are related directly to the inadequacies in these areas. If NIE conducts its awesome responsibility in the most responsible yet technically competent manner, support for educational research and experimentation can be generated.

First, many of the present problems confronting NIE are directly attributed to the manner of topic or project selection. While NIE has initiated some 'new projects', many were on-going projects transferred from other agencies to NIE. Findings from these projects in many instances will lack validity and reliability; and in other instances, the treats to external validity have been so great that experimental mortality was inevitable. There exists a need for a predictive model based on empirical evidence from previous federally-sponsored education experiments; without such a model it will be difficult indeed for NIE to refuse to continue, if not expand, many of these 'old' projects.

Second, Federally-sponsored and imposed research and/or experimental designs in a large number of education projects often lack credibility or relevance to the ultimate contituency -- public schools. For example, when designs which are inflexible are imposed on 'test beds' operating in the social, political, and economic milieu in which schools must operate, conflict is bound to occur. In other instances, when criteria for assessment are differently ranked in order of priority by local and federal agencies, the results of research have been of questionable use. Experiments need greater multi-level design congruency.

Third, major deficiencies have occurred during the implementation phases of large scale research or experimental efforts funded by federal agencies. There has, to date, been little investigation of the nature of the effects -- both intended and unintended -- of this federal presence. Although similar confounding effects may be present in non-federally sponsored experiments, perfunctory evidence suggests that the longer hierarchical chain associated with federal projects may increase the probability of unintended negative consequences. Chris Argyris, ("Some Unintended Consequences of Rigorous Research", Psychological Bulletin, 1973) using organizational theory as a framework, suggests that the implied dependency or subservience associated with attempts to conduct a rigorous experimental design, may have severely counter-productive impacts on the implementation aspects of field experiments. In effect, structural factors in the organization and implementation of field experiments may have effects that act identically with formal treatment variables. This can lead to very wrong inferences about treatment effectiveness. Participants in experiments almost certainly react to much more than just the official treatment condition.

NIE, with its abiding interest in the integrity of its field experimentation program, must, of course, be concerned with this problem of high experimental rigor resulting in experimental designs which are confounded by the effects of that rigor. NIE may be forced to recognize that very definite experimental design trade-offs exist between rigorousness of evaluation and contamination of results. There are, in effect, implications for the design and management of field experiments in terms of utility of ultimate information payoff.

It is proposed that an effort be conducted to study large-sacle federally-funded experiments and research efforts to develop a crude predictive model; and to apply the model to the Satellite project as a quasi test bed. The implications for this project are great; and those for NIE should lead to greater credibility and acceptance.

DESIGN OF TASK

The purpose of this task is to design a conceptual model for assessing the variety of threats to experimental validity during the selection, design, and implementation of educational research and experimental efforts applying the model to the Satellite project to identify implications for the project and NIE. The phases of the overall evaluation effort would be: (a) to develop a conceptual model based upon a review of the documentation of large scale educational research and experimental efforts conducted by federal agencies; (b) to apply the general model using the documentation of the satellite project from its inception through June 1975; and (c) to report the findings and implications for this project as an experimental and research project and NIE generally.

While hypothesis will be determined after an assessment of documentation of existing projects, several tentative hypothesis and propositions are listed below.

- To the extent that projects are funded or selected on the basis of political considerations, the greater is the probability that objectives are ambiguous, thereby reducing validity and reliability of the experimental or research design and findings.

- To the extent that the project participants are selected from a pool of volunteers, product and process objectives are more likely to be met; conversely, to the extent participants are selected on a random basis, the product and process objectives will be met to a lesser extent.

- To the extent project staff at the project site support the program and have adequate skills to meet the demands of the program, the greater the probability that objectives will be met and the integrity of the evaluation design will be maintained.

- To the extent the evaluation design conflicts with the operational ease of implication of the project, the greater the probability of experimental mortality.

- The greater the degree of difference between participants' perceptions of priority criteria and the perception of the sponsoring agency, the greater the probability that evaluation objectives will not be met.

- To the extent future funding is contingent upon the attainment of project objectives, the higher the probability that project objectives will be met at the expense of evaluation objectives being met.

- The greater the project staffs' participation in planning for the implementation of the project at the local level, the greater the probability that the operational objectives of the project will be met.

- The degree to which the evaluation design accommodates the administrative and organizational structure and operations at the site, the higher the probability that operational objectives will be met.

- To the degree that an independent third-party acts as a catalyst, the greater the probability that process objectives will be met.

- The degree to which an independent third-party evaluation or program audit provides services, the higher the probability that product objectives will be accomplished.

- The greater the degree that the technique being tested threatens vested interest groups within the on-site institution, the lower the probability 'controls' will provide reliable results for comparison.

The major steps involved include: (a) selection of experimental and research projects to be analyzed; (b) review of project documentation, formal and informal; (c) development of the conceptual model; (d) application to the satellite project through review and analysis of existing documentation and on-going operations; (e) determine implications of satellite project resulting from the application of the model; and (f) determine implications of the model for NIE.

First, in selecting programs, a multi-phase process is proposed; projects should meet the following criteria:

- Occurred between 1967 and 1972;
- Have been completed (final results are available pertaining to the objectives of the experiment);
- Had some form of defensible experimental design;
- Involved technique or process of national interest or concern;
- Involved Federal, state, and local agencies in design and/or implementation phases;
- Had Federal funding as the predominant fiscal component or source of support;
- Have sufficient documentation available to provide a specification of program objectives, experimental design, treatments, subjects, measurement instruments, program-administrative and management, organization, schedule, and principal results and conclusions.

Second, after developing procedures for analyzing documentation, the objectives of documentation analysis are to identify rates of occurrence of different types of problems and events, how they arose, how they were resolved, how they affected the experiment, and what inferences about underlying causes are supported by the documentation. To accomplish these objectives, criteria and procedures will be needed to assure the accuracy and reliability of information extraction and classification. All documentation and classification will be analyzed independently by two persons, and the generation of causal inferences made independently by at least two other reviewers based on data from the initial (reconciled) documentation analysis in order to meet requirements of accuracy and reliability. The analysis will depict differential occurrences of different types of problems, their apparent causes, consequences, and some ordered or rated inferences (according to subjectively established likelihoods) of actual or underlying causes.

Third, based upon the analysis, a conceptual model will be developed covering topical areas reflected in the tentative hypotheses. This 'crude' model will then be reviewed by a panel of experts and NIE officials and possibly modified or expanded prior to application.

Fourth, in applying the model to the Satellite project, existing documentation will be reviewed; gaps will be identified, after which additional information will be gathered from official and additional sources. These data will be collected through the use of semi-structured interview forms which will have been developed. Regarding documentation of the on-going program, staff will use this project's documentation system, interim evaluation reports submitted by on-site evaluators and documentation captured as a primary source by PCI. In the event that on-going documentation appears to be inadequate, on-site data collection and observation will be conducted.

Fifth, in conducting the analysis of the model as applied to the Satellite project, several steps are involved: (a) coding and organizing data with respect to categories or events, problems, and causes as given in program documentation and with respect to preliminary inferences about causes drawn from the research team; (b) development of methods of scoring and weighing discrepancies in perceptions obtained from different respondents; (c) combining and interpreting data, specifically documentation and interviews;

and (d) synthesize and interpret data. With regard to the latter step, it is important to note that since the purpose of this task is not to confirm the hypothesis with high statistical levels of reliability the focus will be on processes which have occurred as a result of external factors attempting to show relationships.

Sixth, in reporting the findings, an effort will be made to determine the specific implications of the model with regard to the Satellite project and for NIE generally. With respect to the former, one finding might be that the project was doomed for experimental mortality since early inception in light of the manner and basis for funding. On the other hand, a finding might be that the project should be continued but funded as an operating project attempting to demonstrate specific facets of it. Regarding implications for NIE if the model has any utility, it should certainly be field-tested and further refined. And in certain instances certain components could be used in the development of procedural checklists and guidelines to be used in the selection, design, and implementation of projects in the future.

ECONOMIC ANALYSIS OF SATELLITE-BASED EDUCATIONAL SERVICES

I. THE ECONOMIC ANALYSIS COMPONENT OF THE PCI EVALUATION PLAN

The decision to implement a satellite TV delivery system will depend on (1) the economic attractiveness of the system, and (2) non-economic factors such as educational impact, receptiveness to innovation by school decision makers, and coordination of program producers, satellite operators, and school systems. The following economic analysis addresses only the economic attractiveness of satellite TV education systems, and the relative economic attractiveness of alternative systems.

The economic analysis measures satellite TV education systems and alternatives against a criterion of viability without federal subsidy. If the system is not viable without subsidy, the analysis can be interpreted as defining for the federal government the size of subsidy that would be required to achieve viability, and the type of subsidy that will be necessary (e.g., grants for programs like Sesame Street; guarantees to satellite operators; subsidized school system coordination; or something quite different).

The economic structure of a satellite delivery system to serve education is dominated by two factors: (1) the large non-recurring investments at the beginning and (2) the economies of scale for reaching large audiences that are geographically dispersed. The large initial investment is crucial because it implies risk for the investor, whether private or public, so long as there is uncertainty about the commercial viability of a satellite system oriented to the needs of education. This is not a system that can be started on a shoestring and developed piece by piece the way an individual teacher might develop her course material during the course of a semester. RCA estimates that $1,000,000,000 would be involved in implementing a full scale system -- a major commitment even for our major corporations and for American education. The economies of scale in a satellite system derive directly from the high cost of generating programs and transmitting them through a satellite to be available over a wide geographic area. However, with low-cost receivers the extra cost for each site receiving the signal is relatively low. The critical issue is whether the potential viewers can be organized to exploit the economies of scale that are implicit in the satellite technology. The satellite broadcasts over a broad multi-state geographic area and American education has traditionally valued local autonomy, so there is real uncertainty about whether schools will be willing and able to coordinate their expectations about content of broadcasts, the timing and other conditions of delivery via satellite, and coordinate payment for the satellite-based educational services.

The ESCD demonstration of 1974-1975 is a regional approach to reconciling the heterogeneous needs of users as they strive to exploit the economies of scale of the satellite. The three regional contractors have worked at coordinating educational users in their region with programming that caters to regional needs, involving schools that will use the broadcasts, and cutting through some of the normal bureaucratic red tape that constrains innovation in education (e.g., ARC getting credits for teachers at ESCD sites.) Not being tested in this demonstration are alternatives to the regional approach such as serving handicapped students distributed throughout the country (a national approach) or focusing on homogeneous occupational groups such as doctors, engineers, computer programmers, and other adults in the labor force.

II. OBJECTIVES AND STRATEGY OF THE PCI ECONOMIC ANALYSIS

A. Objectives

1. Clarify the conditions under which it will be economically attractive to use an operational system of satellite-based educational services (SBES) on an extensive and/or intensive basis.

2. Define the next steps necessary for launching (or preventing) an operational system that will be economically attractive (unattractive).

B. Strategy

The PCI approach has been developed using the following strategy:

1. Identify the factors critical for an operational system to become economically attractive.
2. Focusing on the ESCD demonstration, identify the information potentially available about the critical factors that could be used to reduce uncertainty for decision-makers.
3. Develop a practical approach to exploit the information from the ESCD demonstration and additional information outside the demonstration as necessary.
4. Assess the adequacy of the evidence and analysis to influence important decisions.

Critical Factors

Eight key factors influencing the attractiveness of an operational system have been identified. The first four factors are characteristics conducive to success of a satellite-based system.

1. Economies of Scale are exploited by serving very large audiences.
2. Dispersed audience with learners geographically separated from one another.
3. Difficult topography makes alternative delivery systems expensive.
4. Convenience because of the satellite saves time for learners whose time is valuable (e.g., doctors, engineers, school teachers).

Four other factors are causes for concern among decision-makers considering commitments to satellite delivery systems:

5. Coordination among users to secure agreement on the content of educational materials transmitted, specifications for delivery to the learners, and payment for programs and satellite delivery.

6. Coordination of program producers, satellite operators, and school systems to efficiently utilize the satellite; will there be enough high quality programs? Are there satellite applications for use in non-peak periods?

7. The economic life of the satellite, related equipment, and programs considering advancing state of the art in communications and the obsolescence of educational programs over time.

8. Shrinking of the prime market for satellite broadcasts due to (1) encroachment by micro-wave linkups and public broadcasting, and (2) out-migration from the sparsely populated areas that are prime markets for satellites.

Satellite broadcasting should be economically attractive in situations where the favorable factors were operative and where the decision-makers could be satisfied that the four unfavorable factors will not be a serious threat.

Information Potentially Available From the Demonstration About the Key Factors

The ESCD demonstration provides a limited "test bed" for learning about how a satellite system would actually work in the Rocky Mountains, Alaska, and Appalachia. The demonstration is well suited to reducing uncertainty on some issues and not on others.

1. Regarding economies of scale, the demonstration transmits only to a small sample of the potential sites within the region testing effectiveness but not effective demand. These samples of 56, 17, and 15 sites per region can be treated as a sample from the much larger number of potential sites in the same region for an operational system serving the entire region; the 88 sites also constitute a sample, though a much more modest and less representative sample, of potential demand for nationally distributed satellite-delivered educational programs.

2 & 3. Regarding dispersed populations in difficult topographical areas, there is some variation within the demonstration from Alaska's extreme dispersion and difficult topography to the Appalachia sites which are not particularly isolated from other communications and transportation.

4. Learner time has a high value for adults in the labor force and is negligible for analysis of education for young children in schools. The six in-service training programs for teachers are the best test of service exploiting the value of saving learner time; it is unfortunate that there is no other ESCD continued education component such as an MIT course for engineers.

5. Coordinating satellite users will be tested with three different approaches but by the three regional contractors. They will certainly not exhaust the range of possibilities for user coordination so alternatives outside ESCD should be assessed.

6. Coordination of producers, satellite delivery and schools will be tested in ESCD to a limited extent. NASA and the Federal Government roles in funding the demonstration are different from the roles of a private satellite operator and non-federal organizations.

7 & 8. The "economic life of satellites and programs" and the "size of the potential market" can be analyzed, but depend on factors outside ESCD including assessment of the advancing state of the art in satellites and competing technologies, demographic trends, etc.

Exploiting Information From The ESCD Demonstration And Other Sources

The PCI economic analysis will accomplish the following six things:

1. Document the actual cost of the 13 programs demonstrated in ESCD.

2. Provide a model for cost analysis that facilitates comparisons among programs and extrapolations from "demonstration" conditions to "operational" conditions. The cost analysis model will distinguish between costs that are "fixed" or "variable" with respect to audience size, and costs that are "fixed" or "variable" with respect to specific programs being transmitted by satellite.

3. Estimate the costs for an operational satellite system transmitting the thirteen programs from the ESCD demonstration, using assumptions about audience size and economic life of the satellite and programs appropriate to an operational system.

4. Estimate the cost of alternative educational programs used before and after ESCD and compare them to the satellite-based educational program.

5. Sensitivity analysis testing the effect on cost per viewer hour of changes in assumptions when uncertainty exists.

6. Distribution of costs among the program producer, the satellite operator/broadcaster, school systems, and individual learners.

Assess Sufficiency

The final step of the PCI strategy is to assess the sufficiency of the evidence and analysis for decisions to be made about next steps on implementation of an operational satellite system. Two key questions for each decision-maker will be:

1. Will it be economically attractive for us to go ahead, given our knowledge and the PCI analysis?

2. Will the other key decision-makers also do the things that we need from them? For example, the satellite operator wants to be satisfied that he will make profits and also to be satisfied that it will be profitable for producers to supply enough programs to fill the satellite time available with good quality programs, he also wants to know users will accept the programs and pay for them, and also that the FCC will permit the entire system to operate on a large enough scale to make it economically viable.

III. THE PCI APPROACH

The PCI approach is divided into four sections: A. The Cost Analysis Model; B. Outputs From The Cost Analysis; C. Inputs to the Cost Analysis; and D. Data Collection.

A. The Cost Analysis Model

The basic cost analysis model is described in Figure VIII-1. All costs fall into four categories. The first key distinction is between costs that are "fixed" or "variable" with respect to the number of receiving sites; the second key distinction is between costs that are "fixed" or "variable" with respect to the specific program being transmitted; i.e., they are "independent" or "dependent" on what program is being used.

FIGURE VIII-1

COMBINATIONS OF FIXED/VARIABLE COST FACTORS TO BE CONSIDERED IN THE COST MODEL FOR SATELLITE BASED EDUCATIONAL SERVICES (SBES)

		VARIATION WITH RESPECT TO NUMBER OF SITES	
		FIXED	VARIABLE
VARIATION WITH RESPECT TO THE SPECIFIC PROGRAM BEING OFFERED	FIXED (independent of program)	A	B
	VARIABLE (Dependent on program)	C	D D1. SBES Related Expenditures D2. Non-SBES Related Expenditures D3. Value of Learner Time

The costs for the 13 programs demonstrated in ESCD will be analyzed and classified for analysis into the categories described below.

A. Costs fixed with respect to the number of sites and fixed with respect to the specific program being offered. (fixed/fixed)

1. Satellite broadcast and transmit availability -- total non-recurring costs for putting satellite in orbit and having total transmit/broadcast capability available for project; divided by the expected useful lifetime (determined by wear, gravitationally caused orbital decay, or technological obsolescence) of the satellite system; annualization factor adjusts for the time value of money allocated to specific program; distribution by program based upon the fraction of total broadcast hours allocable to this program.

A1. _______(\$/Yr)

2. Regional user coordination -- all regional contractor costs not allocated to specific programs. The allocation of these costs to the specific program will be based upon the fraction of total broadcast hours in that region devoted to this program.

A2. _______(\$/Yr)

SUBTOTAL -- GROUP A _______(\$/Yr)

B. Costs fixed with respect to the specific program being offered but variable with respect to the number of sites involved. (Fixed/var)

1. Cost of installation of necessary site hardware -- total installation and purchase cost of hardware divided by the expected useful lifetime (determined by wear or technological obsolescence) of the

hardware; annualization factor adjusts for the time value of money; distribution of costs among specific programs will be based upon the fraction of total terminal usage devoted to this program.

B1. _______(\$/Yr)

2. Cost of repairs and maintenance of site hardware -- costs allocated to this specific program will be based upon the same fraction as B1 above.

B2. _______(\$/Yr)

SUBTOTAL -- GROUP B _______(\$/Yr)

C. Costs fixed with respect to the number of sites involved in any particular region but variable with respect to the specific program offering. (Var/fixed)

1. Development and production of materials -- total of such costs divided by the expected useful lifetime (determined mostly by technological or educational obsolescence); annualization factor adjusts for the time value of money. If materials or programs specifically developed for the project have a significant potential for sale to other users outside the scope of this project, the numerator of this calculation would be the net cost (total cost less expected or observed revenue from sales) of development and production. For previously (i.e., outside of this project) "canned" program offerings, the numerator of this calculation would be the cost of purchase or duplication of the program materials.

C1. _______(\$/Yr)

2. Satellite and broadcast use -- total recurring, operational type costs for satellite and broadcast system for this program (total broadcast hours for this program multiplied by the operational hourly broadcast costs per hour for the satellite system).

C2. _______($/Yr)

SUBTOTAL -- GROUP C _______($/Yr)

D. Costs varying both with respect to the number of sites involved in a particular region and with respect to the specific program offering. (Var/var)

1. Satellite Based Educational Service related expenditures.

   a. Site equipment operations. ___________
   b. Teacher time and support materials. ___________
   c. User coordination for a specific program. ___________

SUBTOTAL D1. ___________

2. Non-SBES related expenditures for the same course.

   a. Teacher time and support materials. ___________
   b. Other costs. ___________

SUBTOTAL D2. ___________

3. Value of learner time. ___________

B. Outputs From the Analysis

The outputs from the analysis are best summarized by the output formats that have been developed. The thirteen educational programs that are being tested will be the basic units for analysis. The output formats which follow illustrate the type of information that will be available at the end of the analysis. The use of brackets indicate parameters that can be changed according to the program of interest, #, etc.; for example, the same format may be used to analyze thirteen programs given any of three assumptions about the number of sites observing it. The same format may be used for analyzing traditional non-satellite instruction programs.

1. Documenting The Actual Costs Of Each Specific Program In The ESCD Demonstration (Output Format #1).

This format provides the basic descriptive information for each of thirteen programs, summary statistics for comparisons to alternative programs, and an analysis of costs into twelve subcategories, and the derivation of the three summary statistics from the cost subcategories. The "cost per viewer hour" (CVH) is for comparisons among alternative uses of satellite time -- the total of satellite related costs divided by viewer hours. This statistic includes the cost of teacher time and materials at the receiving site that were directly related to the satellite delivered material. The second summary statistic, "Expenditures for Course/Learner," is for comparisons of between courses that use satellites and alternative courses that do not use the satellite. Total expenditures for the course are divided by the number of learners. Expenditures include the cost for course expenditures unrelated to the satellite material; for example, in a junior high school career education class trips, special projects, and segments of the course that do not depend upon the satellite in any way would be classified as non-satellite related costs. In the materials distribution application the materials delivered by satellite may be a substitute for teacher time or a supplement for enrichment of the course making a difference in the total cost to the school for teaching the course; in either case, it would be unrealistic to attribuce the cost for a whole semester course to the one or two hours of television material that was received via satellite. The third summary statistic, "cost (including value of learner time) divided by number of learners," will be appropriate for a social analysis of courses. This statistic will be particularly relevant with courses for adults who are employed and whose time has an economic value. For example, a teacher training course available at a convenient location for teachers in isolated rural areas may make it possible for teachers in "hardship posts" to continue their professional development, obtain promotions and pay raises, and continue to be willing to work in the "hardship posts." A satellite might substantially reduce the amount of time (i.e. expense) for these teachers to obtain professional advancement when compared to alternatives such as summer schools at a remote campus; this summary statistic is an appropriate cost to compare with the value to the learner, the school system, or community.

COST ANALYSIS

OUTPUT FORMAT #1 - ACTUAL COSTS IN DEMONSTRATION FOR A SPECIFIC PROGRAM

SUMMARY OF COSTS FOR
[EARLY CHILDHOOD EDUCATION]*
[DURING ESCD DEMONSTRATION]

DESCRIPTION

SATELLITE BASED EDUCATION SERVICE CODE #	DEMO 1
NAME OF PROGRAM	Early Childhood Education
REGION	Alaska
TARGET GROUP	3-5 Years and Mothers in Native Villages
PROGRAM HOURS	___ Segments of 30 Minutes = ___ Hours
AVERAGE AUDIENCE DURING DEMO (PRIMARY)	Total 200; Mothers 75; Children 125
AVERAGE AUDIENCE: LAST 4 SEGMENTS (PRIMARY)	Total 190; Mothers 70; Children 120
SECONDARY AUDIENCE: ENTIRE DEMO/FINAL FOUR	100/75

SUMMARY STATISTICS - COST

E4-SBES Related Costs/Viewer Hour	$
F4-Expenditures for Course/Learner	$ 500
G5-Cost (Including Value of Learner Time)/Learner	$ 500

* Illustrative data have been inserted to make the format less abstract.

ANALYSIS OF COSTS	$/Yr
A. Fixed Cost	
1. Broadcast/Transmit Capability-Allocated	25,000
2. Regional Coordination-Non Specific-Allocated	15,000
SUBTOTAL -- FIXED/FIXED	40,000
B. Cost Varying With # Sites, Not Programs (VAR/FIXED)	
1. Site Installation	8,000
2. Repairs and Maintenance	2,000
SUBTOTAL -- VAR/FIXED	10,000
C. Costs Varying By Program, Not By Sites (FIXED/VAR)	
1. Development and Production of Program	17,000
2. Broadcast and Satellite Use	3,000
SUBTOTAL -- FIXED/VAR	20,000
D. Costs Varying with Program and Sites (VAR/VAR)	
1. Directly Related to SBES	
a. Site Equipment Operations	5,000
b. Teacher Time and Support Materials - SBES Related	15,000
c. User Coordination - Specific to Application	0
SUBTOTAL (D1)	20,000
2. Not Related to SBES	
a. Teacher Time -- Non-Satellite	9,000
b. Other Costs -- Non-Satellite	1,000
SUBTOTAL (D2)	10,000
3. Value of Learner Time	0

E. SBES Related Costs -- Total and CVH

1. Total SBES Related Costs/Yr. (A, B, C, & D1)	90,000
2. Average Audience -- Sum of All Sites Viewing It	200
3. Satellite Hours Received/Year	
4. Total SBES Related Cost/Viewer Hour	

F. Analysis of Expenditure - For Comparison to Alternative Courses

1. Total SBES Related Costs (A, B, C, & D1)	90,000
2. Costs Not Related to SBES (D2)	10,000
3. Total Expenditures for Course (A + B + C + D1 + D2)	100,000
4. Total Expenditures/Learner	$500

G. Analysis of Total Cost (Including Value of Learner Time)

1. SBES Related Costs	90,000	(90 %)
2. Costs Not Related to SBES	10,000	(10 %)
3. Value of Learner Time	0	(0 %)
4. Total Cost (Including VLT)	100,000	(100%)
5. Cost (Including VLT)/# Learners	$500	

2. Comparison of a Satellite Delivered Program With Non-Satellite Programs For The Same Audience (Output Format #2).

Output Format #2 is an abbreviated format with less detailed information than Output Format #1. It includes all of the necessary information about one of the thirteen satellite programs, or one of the alternatives to a satellite program, for subsequent comparisons among alternative courses for the same target audience. This format may be used also to extrapolate from experience observed in the demonstration to the estimated cost of the same program with an operational satellite system serving an audience larger than the demonstration sites.

The cost for a program will represent the average of costs observed at three or more sites using a specific program. The sample Format 2 summarizes an alternative to the Early Childhood Education Program in Alaska. Let us assume that three sites in Alaska used nursery school programs before the satellite program was available. In this case the cost for the nursery school program in those three sites would be collected, averaged, and summarized according to the Format #2. Since no satellite was involved, all of the costs would be in the D2 category costs that are not related to the satellite. Some alternatives would use the C and D categories. It is possible that after the demonstration there will be alternative programs that use videotapes developed during the demonstration without the satellite; for example, the ARC teacher training materials may be distributed by microwave after June, 1975.

COST ANALYSIS

OUTPUT FORMAT #2 - COST/LEARNER FOR COMPARISONS AMONG ALTERNATIVE COURSES

SUMMARY OF COSTS FOR
[ALTERNATIVE PRIOR 1-1 TO] [EARLY CHILDHOOD EDUCATION]
[WITH OPERATIONAL SATELLITE SYSTEM]
[SERVING REGIONAL AUDIENCE]

DESCRIPTION

PROGRAM CODE [FOR ALTERNATIVE]	[PRIOR 1-1]
NAME OF PROGRAM IN DEMONSTRATION	[EARLY CHILDHOOD ED]
NAME OF ALTERNATIVE	[NURSERY SCHOOL]
REGION WHERE ACTUALLY USED	[ALASKA/3 SITES]
TARGET GROUP	[3-5 YEARS OLD; MOTHERS]
RECEIVING AUDIENCE (ASSUMPTION)	[ALASKA]
OPERATIONAL/DEMO	[OPER]
# SITES/AVERAGE AUDIENCE (ASSUMPTION)	[________/________]

SUMMARY STATISTICS - COST

SBES Related Costs/Viewer Hour	$ 0
Expenditures for Course/Learner	$
Cost (Including Value of Learner Time/Learner)	$ 0

ANALYSIS OF COSTS (Costs are FIXED or VARIABLE with respect to # SITES/PROGRAM Used)

A. FIXED/FIXED	[________]
B. VAR/FIXED	[________]
C. FIXED/VAR	[________]

D. VAR/VAR

1. Directly Related to SBES [________]

2. Not Related to SBES [________]

3. Value of Learner Time [________]

ANALYSIS OF COSTS (Including Value of Learner Time) - For Comparison to Alternative

G1. Total SBES Related Costs (A, B, C, + D1) $________ (__%)

G2. Total Not Related to SBES (D2) $________ (__%)

G3. Value of Learner Time (D3) $________ (__%)

G4. Total Cost (Including Value of Learner Time) $________ (100%)

3. Comparison of Courses Using Satellite With Alternative Courses for the Same Audience (Output Format #3).

Satellite courses should be compared to alternative courses for the same audience. Alternative courses will be coded, described and costed based on a set of common assumptions, the "base model" for comparisons. In the sample of Format 3 the Alaskan Early Childhood Education Program is used to illustrate the results of the analysis. Suppose nursery schools existed at seven sites before the demonstration and after ESCD three of the seven nursery schools used the ESCD videotapes. The potential audience is relatively small in Alaska and assume that tests show no pre-school programs outside Alaska want the program. The cost analysis could show the satellite saves money on teachers but not enough to overcome the satellite costs with such a small audience. NOTE -- THIS IS AN EXAMPLE WITH HYPOTHETICAL NUMBERS TO ILLUSTRATE THE PRESENTATION OF RESULTS FROM THE ECONOMIC ANALYSIS. A separate assessment will be essential regarding the educational merit of the programs and whether the additional cost for satellite distribution is justified.

COST ANALYSIS

OUTPUT FORMAT #3 - COMPARISON OF PROGRAM [1] WITH ALTERNATIVE COURSES

DESCRIPTION OF PROGRAM AND AUDIENCE

PROGRAM CODES: DEMO 1 - Early Childhood Ed
PRIOR 1-1 - Nursery School
POST 1-1 - Nursery School
POST 1-2 - Nursery School With Demo VTR

AUDIENCE: Mothers and 3-5 Year Olds

BASE MODEL FOR COMPARISONS: Operational System; ATS-F Satellite

SUMMARY ASSESSMENT: [Early Childhood Education] Demo Program is economically attractive [never] [since audience is limited to Alaska, potential primary audience is 500 with estimated penetration of 50/200 potential sites, potential cost is high even if alternatives require teacher but demo doesn't. Demand outside Alaska negligible for 3-5 Yr. Olds -- perhaps usable for anthropology courses.]

	SBES Related Costs ($)	Non-SBES Related Costs ($)	Value of Learner Time ($)	Total Cost ($)	T.C.Per Learner ($)	T.C. Per Learner -- % of Program [1] Costs
Demonstration/17 Sites/200 Learners						
Demo 1	90K	10K	0	100K	$500	100%
Prior 1-1	0	20K	0	20K	$100	20%
Post 1-1	0	20K	0	20K	$100	20%
Post 1-2	20K	20K	0	40K	$200	40%
Operational/17 ESCD Sites /200 Learners						
Demo 1	40K	10K	0	50K	$250	100%
Prior 1-1	0	20K	0	20K	$100	40%
Post 1-1	0	20K	0	20K	$100	40%
Post 1-2	10K	20K	0	30K	$150	60%

	SBES Related Costs ($)	Non-SBES Related Costs ($)	Value of Learner Time ($)	Total Cost ($)	T.C. Per Learner ($)	T.C. Per Learner % of Program Costs
Operational/[50] Alaska Sites/500 Learners						
Demo 1	50K	25K	0	75K	$150	100%
Prior 1-1	0	50K	0	50K	$100	67%
Post 1-1	0	50K	0	50K	$100	67%
Post 1-2	30K	50K	0	80K	$160	107%
Operational/[50] Sites Nationwide/500 Learners						
Demo 1	90K	25K	0	115K	$230	100%
Prior 1-1	0	50K	0	50K	$100	43%
Post 1-1	0	50K	0	50K	$100	43%
Post 1-2	30K	50K	0	80K	$160	144%

4. Analysis of the Cost Structure for Each Demonstration Course (Output Format #4).

Four distinct types of programs are being demonstrated: (a) teacher in-service training; (b) children in schools; (c) adult general audiences; and (d) materials distribution. The PCI analysis will focus attention on differences in the cost profile for each type of course.

Format #4 illustrates the presentation for the results. The data all derive from the common data base. Common assumptions will be made (base model) for comparability -- e.g., regional distribution, operational system, ATS-F satellite.

Some features of the analysis are predictable a priori and others will only emerge with experience from ESCD. The potential audience for teacher training will be a fraction of the school children they teach. The value of learner time (D3 in the analysis) will be zero for young children and may be high for teachers. Programs for general audiences may not require teachers at the receiving site (D1 and D2). Materials distribution will provide programs with very low cost to satellite users for program development and production (C1).

The relative weights are unclear for these "predictable features;" the large initial cost will dominate the cost structure in a one year demonstration but may become relatively unimportant for an operational system with a large audience. The cost model can generate the functions showing the relationships.

COST ANALYSIS

OUTPUT FORMAT #4 -- ANALYSIS OF COST STRUCTURE FOR VARIED SATELLITE COURSES (% OF TOTAL COST FOR THE SBES) - [REGIONAL DISTRIBUTION]

	TYPE OF PROGRAM															
	TEACHER IN-SERVICE							CHILDREN IN SCHOOL					ADULTS GENERAL AUDIENCE				
COST CATEGORY	DEMO 4	DEMO 6	DEMO 7	DEMO 8	DEMO 9	DEMO 11	AVERAGE TIS	DEMO 1	DEMO 2	DEMO 3	DEMO 10	AVERAGE CIS	DEMO 5	DEMO 12	AVERAGE AGA	MATERIALS DISTRIBUTION (DEMO 13)	TOTAL ALL APPLICATIONS
A. FIXED/FIXED																	
1. Satellite Available								.30									
2. Broadcast Available								.10									
3. User Org. Non-Specific								.10									
SUBTOTAL								.50									
B. VAR/FIXED																	
1. Site Installation								.05									
2. Repairs & Maintenance								.01									
SUBTOTAL								.06									
C. FIXED/VAR																	
1. Development & Production of Program								.19								Very Low	
2. Broadcast & Satellite Use								.01									
SUBTOTAL								.20									

COST ANALYSIS

OUTPUT FORMAT #4 -- ANALYSIS OF COST STRUCTURE FOR VARIED PROGRAM COURSES (% OF TOTAL COST FOR THE SBES) - [REGIONAL DISTRIBUTION]

	TYPE OF PROGRAM																
	TEACHER IN-SERVICE							CHILDREN IN SCHOOL					ADULTS GENERAL AUDIENCE				
COST CATEGORY	DEMO 4	DEMO 6	DEMO 7	DEMO 8	DEMO 9	DEMO 11	AVERAGE TIS	DEMO 1	DEMO 2	DEMO 3	DEMO 10	AVERAGE CIS	DEMO 5	DEMO 12	AVERAGE AGA	MATERIALS DISTRIBUTION (DEMO 13)	TOTAL ALL APPLICATIONS
D. VAR/VAR 1. SBES Related a. Site Equipment Use																	
b. Teacher Time & Support Material													0 or Low	0 or Low	0 or Low		
c. User Coordination-Specific																	
2. Non-SBES Related a. Teacher Time - Non-SBES													0 or Low	0 or Low	0 or Low		
b. Other Costs Non-SBES																	
3. Value of Learner Time	Hi	Hi	Hi	Hi	Hi	Hi	Hi	0	0	0	0	0	?	?	?	0	
SUBTOTAL																	

5. The Sensitivity of Cost Per Viewer Hour to Changes of Assumptions About Strategic Factors (Output Format #5)

Some uncertainty about key factors will be unavoidable. When cost per viewer hour changes a lot depending on an uncertain factor, the factor is crucial and should receive careful attention to ensure forecasts are sound and that management does what is possible to manage the strategic factor.

The sensitivity analysis will generate careful assessments of alternative futures, not merely extrapolation mechanically from the ESCD experiment. For example, developing and producing programs is expensive. FRMS spent $1.6 million on early childhood programs that were never produced, a fact which should be remembered but not allowed to distort projections of future costs for an operational system. If the cost of program material appears critical, PCI will focus attention on exploring alternative low-cost approaches to program development. PCI will explore programs available off the shelf: the Department of Defense, programs from NIT, CTW, and other producers serving schools today. There are low-cost approaches to local production like the portapack experiences of Grant Maslind in Hartford and Samoa. The materials distribution program will make programs available at a modest cost based on use rather than developing special materials.

Format 5 illustrates the presentation format with varied assumptions about the economic life of the satellite. For the demonstration, the economic life is taken to be one year,but for an operational system the ATS-F satellite would be expected to have a 5-7 year life. Amortizing the satellite over seven years would reduce the annualized cost of the satellite substantially. The impact on cost per viewer hour will depend on the weight of the satellite cost in the CVH. For example, with a very large audience (millions of viewers) the value of learner time may so dominate the total costs that CVH is relatively insensitive to a change of two years in estimated life of the satellite.*

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* See Marshall Jamison & Stephen T. Bett, Satellite Education System Costs For Three Model Developing Countries (August, 1973).

The strategic variables to be analyzed in this fashion include the following:

a. Alternative Satellites - Hughes, RCA, CTS, ATS-F, Comsat

b. Economic Life of Satellite, Ground Equipment, and Programs

c. Receiving Site Equipment Cost (Alternative Vendors; Economies of Large Purchases; Intensive Terminals Vs. Receive Only Terminals)

d. Program Production and Development Cost (Net of Revenue From Resale to Others)

e. Teacher Salaries Saved by Substitution Vs. Enrichment Programs

f. Value of Learner Time in Teacher In-Service Training

g. User Coordination Costs -- ESCD Regional Contractors, School Consortiums, Commercial Distributors, Non-Profit, Government.

h. Number of Sites

i. Viewers Per Site

j. Price to Users -- Effect on audience size.

The alternatives will be analyzed and plotted, not mechanically extrapolated.

COST ANALYSIS

OUTPUT FORMAT #5 -- SENSITIVITY OF COST PER VIEWER HOUR TO CHANGE OF ASSUMPTIONS ABOUT STRATEGIC FACTORS - 4 TYPES OF PROGRAM

A. SUMMARY ASSESSMENT: Cost per viewer hour is [Degree of Sensitivity] to changes of assumption about [ ] for [Type of Program].

B. DESCRIPTION

Strategic Factor [A1] [Economic Life of Satellite]

Range of Assumptions: (1 = most favorable)

* = Best estimate used in other parts of cost analysis

1. [9 Years]
2. [7 Years *]
3. [5 Years]
4. [3 Years]
5. [1 Year]

Base Model For Comparisons:

[Regional Audience]
[ATS-F Satellite]
[ESCD Applications]
[Operational System]

C. EFFECT ON ANNUALIZED COST OF SATELLITE

[Economic Life of Satellite]	9	7	5	3	1	Years
Annualized Cost of Satellite						$/Year

D. EFFECT OF COST PER VIEWER HOUR FOR FOUR TYPES OF PROGRAM

[ECONOMIC LIFE OF SATELLITE]	(AVERAGE CVH)									
	TEACHERS		SCHOOL CHILDREN		ADULTS		MATERIAL DISTRIBUTION		ALL PROGRAMS	
	CVH	% OF *	CVH	% OF *	CVH	% OF *	CVH	% OF *	CVH	% OF *
1. 9 Years										
2. 7 Years*		100		100		100		100		100
3. 5 Years										
4. 3 Years										
5. 1 Year										

* Best estimate -- used in other parts of cost analysis.

6. Distribution of Costs Among Satellite Operators/Broadcasters, Program Producers, School Systems, and Learners (Output Format #6)

The distribution of costs for a satellite delivery system can be critical. It is unlikely that an integrated system will ever evolve with a single organization producing programs, transmitting them, operating the satellite, receiving the programs, and integrating them into an educational program.* Consequently, it is not sufficient for the system to be profitable for the satellite operator unless it is also profitable for program producers to supply the program content for broadcasting, and for the school systems to use the material, and for the learners to use the system in those situations where the individual learners have a choice like adult continued education. The growth and demise of the "knowledge industry" in the 1960's is attributable at least in part to an inadequate supply of high quality program material rather than to lack of innovations in delivery systems via television, computer, etc.

Each decision-maker will be interested in knowing (1) Will it be profitable for my segment of the satellite education system? and (2) Will the other parties on whom I am depending also find it economically attractive to do their part?

Output Format 6 separates costs into four groups: Broadcast/Satellite Costs; Program Producer Costs; School System Costs (Including The Cost Of User Coordination); Learner Costs. For each of these groups the type of cost incurred in the demonstration are characterized as fixed or variable according to the cost model. Costs are analyzed from the point of view of each important group in the satellite system, analyzing the costs for the thirteen demonstration programs with varied levels of audiences. The results are expressed in "Cost Per Viewer Hour" and in the cost units appropriate to decision-makers in each group. Specifically, broadcasters/satellite operators will be concerned with the "Cost Per Broadcast Hour" for comparisons to their own judgment about the potential revenue per broadcast hour; program producers will be interested in the "Cost Per Hour of Program Material" in order to compare with their own ability to produce comparable material at a similar cost; the school systems will be interested in the "Cost Per Student" to judge the realism of using satellite-based courses compared to their normal expenditures; learners should care about the "Cost Per Learner" for each program where the learner's time has an economic value. This will facilitate judging whether these programs will be attractive to adult learners and whether institutions are likely to buy them.

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* Major corporations such as IBM do operate large scale, high technology educational systems for efficient training of their own employees and even their customers including the use of computer assisted instruction, program instruction, closed-circuit television, etc.

Government policy-makers or others considering subsidies for satellite-based educational services will find this summary distribution of costs helpful for focusing attention on where the subsidy must be applied and its magnitude. It may be necessary and sufficient to subsidize user organizations if the key problem is the uncertainty of demand. Alternatively, it may be encessary to subsidize the development and production of programming materials for particular viewer audiences which would otherwise be non-competitive but which have high priority for other resons; e.g., providing secondary school education in Alaskan villages or providing education for the handicapped outside metropolitan areas are two examples that may merit subisidies by program.

OUTPUT FORMAT 6

DISTRIBUTION OF COSTS AMONG SATELLITE OPERATOR/BROADCASTER, PROGRAM PRODUCER, SCHOOL SYSTEMS, AND LEARNER

BASE MODEL FOR COMPARISONS:

[ATS-F Satellite]
[All ESCD Applications]
[Operational System]

A. SUMMARY ASSESSMENT

For satellite operator/broadcaster [cost characteristics]
For program procedures [cost characteristics]
For school systems [ ]
For learners [ ]

I. DISTRIBUTION OF COSTS - BROADCASTING/SATELLITE OPERATOR COSTS

A. Type of Costs

Fixed/Fixed - Satellite/Broadcast Capability

Annualized cost - $________________/yr

Fixed/Var - Satellite/Broadcast Use

$/hour broadcast - $________________

B. Analysis of Broadcast/Satellite Costs By Program and Audience Size

[(a). $/broadcast hr. (b) $/viewer hr.]

	Received by:					
	ESCD sites		Same region		Nationally	
	a	b	a	b	a	b
1. Demo 1						
2. Demo 2						
3. Demo 3						
4. Demo 4						
5. Demo 5						
6. Demo 6						
7. Demo 7						
8. Demo 8						
9. Demo 9						
10. Demo 10						
11. Demo 11						
12. Demo 12						
13. Demo 13						
ALL PROGRAMS						

II. PROGRAM PRODUCERS

A. Type of Costs

Fixed/Var -- Development and Production of Programs:
Annualized cost net after proceeds from sale elsewhere. $______/Yr.

B. Analysis of Cost by Program and Audience Size

[(a) $/program material hr. (b) $/viewer hr.]

	Received by:					
	ESCD sites		Same region		Nationally	
	a	b	a	b	a	b
1. Demo 1						
2. Demo 2						
3. Demo 3						
4. Demo 4						
5. Demo 5						
6. Demo 6						
7. Demo 7						
8. Demo 8						
9. Demo 9						
10. Demo 10						
11. Demo 11						
12. Demo 12						
13. Demo 13						
ALL PROGRAMS						

III. SCHOOL SYSTEMS (including cost of user coordination)

(Not included -- the cost of programs and satellite services)

A. Type of Costs

Fixed/Fixed - Regional Coordination Non-Specific $________/Yr.

Var/Fixed - Site Installation - Annualized
Repairs and Maintenance $________/Yr.

Var/Var $________/Yr.

1. Satellite Related

Site Equipment Operation $________/Yr.

Teaching Time - SBES Related $________/Yr.

Support Materials - SBES Related $________/Yr

User Coordination - Specific to Program $________/Yr.

2. Not Satellite Related

Teacher Time - Same Course $________/Yr.

Other Costs - Same Course $________/Yr.

B. Analysis By Program And Audience Size

[(a) Cost Per Student* (b) Cost Per Viewer Hour*]

* Not including cost of programs and satellite delivery.

	Received by:					
	ESCD sites		Same region		Nationally	
	a	b	a	b	a	b
1. Demo 1						
2. Demo 2						
3. Demo 3						
4. Demo 4						
5. Demo 5						
6. Demo 6						
7. Demo 7						
8. Demo 8						
9. Demo 9						
10. Demo 10						
11. Demo 11						
12. Demo 12						
13. Demo 13						
ALL PROGRAMS						

IV. LEARNER COSTS

A. Type of Cost *

Var/Var - Value of Learning Time $__________/Yr.

* These are costs borne by the student in addition to any payment for tuition, program costs, or satellite services.

B. Analysis of Program and Size of Audience

[(a) Cost Per Learner For Program * (b) Cost Per Viewer Hour *]

* These are costs borne by the student in addition to any payment for tuition, program costs, or satellite services.

	Received by:					
	ESCD sites		Same region		Nationally	
	a	b	a	b	a	b
1. Demo 1						
2. Demo 2						
3. Demo 3						
4. Demo 4						
5. Demo 5						
6. Demo 6						
7. Demo 7						
8. Demo 8						
9. Demo 9						
10. Demo 10						
11. Demo 11						
12. Demo 12						
13. Demo 13						
ALL PROGRAMS						

C. Inputs to the Economic Analysis

In order to bridge the gap between the conceptual cost model and the outputs of the cost analysis outlined earlier, a great many items of data are needed. Figure VIII-2 lists 475 separate variables to be collected, many of these variables to be gathered individually at each of the 17 sites in Alaska, the 15 sites in Appalachia, and the 56 sites in the Rocky Mountain States. Figure VIII-2 also lists the likely source from whom to obtain these data including NASA, NIE itself, the three regional coordinating organizations, and the 88 local sites in the ESCD project.

It can be noted in Figure VIII-2 that it may be necessary to develop a questionnaire to be used at the local sites for gathering certain data (see variables 275-475). The bulk of these data could just as easily be gathered in the year following the demonstration year, thus not at all obtruding into the local site operations during the actual demonstration year. Only those data relating to the learner time spent in each program offering -- both directly in contact with the satellite or the satellite-based materials and out of contact with these but still in the context of the overall program offering at that site -- would be more difficult to obtain after the fact than during the demonstration year. PCI will arrange to collect these data in collaboration with the regional contractors. However, since the vast majority of the required data need not be obtained until the summer of 1975, it is not necessary, at this time, to present highly developed data instruments to be used to collect such data. Indeed, a more rational and reasonable approach would entail the judicious observation of existing data and data gathering structures within the three regions during the demonstration year with an eye towards development of such instruments as will be optimal during that year.

A final note on the data requirements is in order. As can be seen in the listing of the data requirements in cost categories D1 and D2 in Figure VIII-2, it will be important to know whether the program materials provided via the satellite for use in each of the program offerings (except those for general audiences) were fully integrated into the overall curriculum for that offering. This knowledge will control the placement of a group of cost data into D1 or D2 as appropriate. The actual integration of satellite materials into the overall program offering may have to be observed during the demonstration year rather than waiting until the demonstration has ended, collaborating with the regional contractors of course.

Neither the time nor the program integration information just discussed is of the nature that it must be collected during the demonstration year or not at all. However, experience shows that such data are subject to decay in validity due to forgetting and other factors more than the salary, budget, and audience information that tends to be recorded in any case.

Figure VIII-3 details the mathematical structure of the cost model showing how each of the 475 variables in Figure VIII-2 are combined to yield the Groups A, B, C, and D costs initially described.

200

FIGURE VIII-2

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
A. FIXED (w.r.t.#sites)/FIXED (w.r.t. programs broadcast)			
1. Satellite broadcast and transmit availability			
a. Satellite channel			
Fixed expenditure per channel (one-time cost)	$	NASA	001
Expected useful lifetime	Yrs.	NASA	002
No. of ESCD channels	(No.)	NIE/NASA	003
Time Value of Money (interest or social discount rate)	(%)	Estimate[1]	004
Annualization factor (function of 002, 004)	(No.)	Formula[2]	005
b. Tracking and telemetry			
Annual tracking and telemetry cost for the satellite as a whole	$	NASA	006
Total broadcast/transmit hours in demonstration year on all channels in use on satellite	Hrs.	NASA	007
Total broadcast/transmit hours in demonstration year on ESCD channels for ESCD demonstration	Hrs.	NASA	008
c. Up-link activities			
Total capital expenditures (one-time cost)	$	NASA	009
Installation expenditures (one-time cost)	$	NASA	010
Expected useful lifetime of up-link facilities	Yrs.	NASA	011
Annualization factor (function of 011, 004)	(No.)	Formula[2]	012
Annual cost of repairs of up-link facility	$	NASA	013

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Annual cost of maintenance (including preventive maintenance) of up-link facility	$	NASA	014
d. Total broadcast hours for each program offering during demonstration year.			
Program offering 1	Hrs.	NASA	015[3]
Program offering 2	Hrs.	NASA	016
Program offering 3	Hrs.	NASA	017
Program offering 4	Hrs.	NASA	018
Program offering 5	Hrs.	NASA	019
Program offering 6	Hrs.	NASA	020
Program offering 7	Hrs.	NASA	021
Program offering 8	Hrs.	NASA	022
Program offering 9	Hrs.	NASA	023
Program offering 10	Hrs.	NASA	024
Program offering 11	Hrs.	NASA	025
Program offering 12	Hrs.	NASA	026
Program offering 13	Hrs.	NASA	027[3]
2. Regional user coordination			
a. Total regional coordination budget for demonstration year in each of the three regions			
Alaska	$	NIE	028
Appalachia	$	NIE	029
Rocky Mountains	$	NIE	030

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
b. Total dollars in these budgets specifically allocated to each of the 13 program offerings.			
Alaska:			
Program Offering 1	$	NIE/Alaska RC	031
Program Offering 2	$	NIE/Alaska RC	032
Program Offering 3	$	NIE/Alaska RC	033
Program Offering 4	$	NIE/Alaska RC	034
Program Offering 5	$	NIE/Alaska RC	035
Appalachia:			
Program Offering 6	$	NIE/ARC	036
Program Offering 7	$	NIE/ARC	037
Program Offering 8	$	NIE/ARC	038
Program Offering 9	$	NIE/ARC	039
Rocky Mountains:			
Program Offering 10	$	NIE/FRMS	040
Program Offering 11	$	NIE/FRMS	041
Program Offering 12	$	NIE/FRMS	042
Program Offering 13	$	NIE/FRMS	043
B. VARIABLE (w.r.t.#sites)/FIXED (w.r.t. programs broadcast)			
1. Installation of necessary site hardware			
a. Alaska			
Initial expenditure on basic ITV terminal installation (one-time cost)	$	NASA/Alaska RC	044

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
No. of basic ITV terminals installed in region	(No.)	Alaska RC	045
Expected useful lifetime of ITV terminals in Alaska region	Yrs.	NASA/Alaska RC	046
Annualization factor (function of 046, 004)	(No.)	Formula^2	047
Total initial expenditure on all ITV terminal options in entire Alaska region (including any necessary audio links)	$	NASA/Alaska RC	048
Expected useful lifetime of ITV terminal options in Alaska region	Yrs.	NASA/Alaska RC	049
Annualization factor (function of 049,004)	(No.)	Formula^2	050
Similar to 044 but for receive-only terminals in Alaska region	$	NASA/Alaska RC	051
Similar to 045 but for receive-only terminals in Alaska region	(No.)	Alaska RC	052
Similar to 046 but for receive-only terminals in Alaska region	Yrs.	NASA/Alaska RC	053
Similar to 047 but for receive-only terminals in Alaska region (but in this case a function of 053,004)	(No.)	Formula^2	054
Similar to 048 but for receive-only terminals in Alaska region	$	NASA/Alaska RC	055
Similar to 049 but for receive-only terminals in Alaska region	Yrs.	NASA/Alaska RC	056
Similar to 050 but for receive-only terminals in Alaska region (but in this case a function of 056, 044).	(No.)	Formula^2	057
b. Appalachia			
Similar to 044 but for ITV terminals in Appalachia region	$	NASA/ARC	058

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 045 but for ITV terminals in Appalachia region	(No.)	ARC	059
Similar to 046 but for ITV terminals in Appalachia region	Yrs.	NASA/ARC	060
Similar to 047 but for ITV terminals in Appalachia region (but in this case a function of 060, 004)	(No.)	Formula[2]	061
Similar to 048 but for ITV terminals in Appalachia region	$	NASA/ARC	062
Similar to 049 but for ITV terminals in Appalachia region	Yrs.	NASA/ARC	063
Similar to 050 but for ITV terminals in Appalachia region (but in this case a function of 063, 004)	(No.)	Formula[2]	064
Similar to 044 but for receive-only terminals in Appalachia	$	NASA/ARC	065
Similar to 045 but for receive-only terminals in Appalachia	(No.)	ARC	066
Similar to 046 but for receive-only terminals in Appalachia	Yrs.	NASA/ARC	067
Similar to 047 but for receive-only terminals in Appalachia (but in this case a function of 067, 004)	(No.)	Formula	068
Similar to 048 but for receive-only terminals in Appalachia	$	NASA/ARC	069
Similar to 049 but for receive-only terminals in Appalachia	Yrs.	NASA/ARC	070
Similar to 050 but for receive-only terminals in Appalachia (but in this case a function of 070, 004)	(No.)	Formula[2]	071
c. Rocky Mountains			
Similar to 044 but for ITV terminals in Rocky Mountains	$	NASA/FRMS	072

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 045 but for ITV terminals in Rocky Mountains	(No.)	FRMS	073
Similar to 046 but for ITV terminals in Rocky Mountains	Yrs.	NASA/FRMS	074
Similar to 047 but for ITV terminals in Rocky Mountains (but in this case a function of 074, 004)	(No.)	Formula[2]	075
Similar to 048 but for ITV terminals in Rocky Mountains	$	NASA/FRMS	076
Similar to 049 but for ITV terminals in Rocky Mountains	Yrs.	NASA/FRMS	077
Similar to 050 but for ITV terminals in Rocky Mountains (but in this case a function of 077, 004)	(No.)	Formula[2]	078
Similar to 044 but for receive-only terminals in Rocky Mountains	[illegible]	NASA/FRMS	079
Similar to 045 but for receive-only terminals in Rocky Mountains	(No.)	FRMS	080
Similar to 046 but for receive-only terminals in Rocky Mountains	Yrs.	NASA/FRMS	081
Similar to 047 but for receive-only terminals in Rocky Mountains (but in this case a function of 081, 004)	(No.)	Formula[2]	082
Similar to 048 but for receive-only terminals in Rocky Mountains	$	NASA/FRMS	083
Similar to 049 but for receive-only terminals in Rocky Mountains	Yrs.	NASA/FRMS	084
Similar to 050 but for receive-only terminals in Rocky Mountains (but in this case a function of 084, 004)	(No.)	Formula[2]	085

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
2. Repairs and maintenance of site hardware			
a. Alaska			
Total cost of repairs of ITV terminals and equipment in Alaska during demonstration year.	$	Alaska RC	086
Total cost of maintenance (including preventive maintenance) of ITV terminals and equipment in Alaska during demonstration year.	$	Alaska RC	087
Total cost of repairs of receive-only terminals and equipment in Alaska during demonstration year.	$	Alaska RC	088
Total cost of maintenance (including preventive maintenance) of receive-only terminals in Alaska during demonstration year.	$	Alaska RC	089
b. Appalachia			
Similar to 086 but for Appalachia	$	ARC	090
Similar to 087 but for Appalachia	$	ARC	091
Similar to 088 but for Appalachia	$	ARC	092
Similar to 089 but for Appalachia	$	ARC	093
c. Rocky Mountains			
Similar to 086 but for Rocky Mountains	$	FRMS	094
Similar to 087 but for Rocky Mountains	$	FRMS	095
Similar to 088 but for Rocky Mountains	$	FRMS	096
Similar to 089 but for Rocky Mountains	$	FRMS	097

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
3. Total hours of terminal usage devoted to each program offering in each region			
a. Alaska			
For all ITV terminals in region receiving program offering 1	Hrs.	Alaska RC	098
For all RO terminals in region receiving program offering 1	Hrs.	Alaska RC	099
For all ITV terminals in region receiving program offering 2	Hrs.	Alaska RC	100
For all RO terminals in region receiving program offering 2	Hrs.	Alaska RC	101
For all ITV terminals in region receiving program offering 3	Hrs.	Alaska RC	102
For all RO terminals in region receiving program offering 3	Hrs.	Alaska RC	103
For all ITV terminals in region receiving program offering 4	Hrs.	Alaska RC	104
For all RO terminals in region receiving program offering 4	Hrs.	Alaska RC	105
For all ITV terminals in region receiving program offering 5	Hrs.	Alaska RC	106
For all RO terminals in region receiving program offering 5	Hrs.	Alaska RC	107
b. Appalachia			
For all ITV terminals in region receiving program offering 6	Hrs.	ARC	108
For all RO terminals in region receiving program offering 6	Hrs.	ARC	109
For all ITV terminals in region receiving program offering 7	Hrs.	ARC	110
For all RO terminals in region receiving program offering 7	Hrs.	ARC	111

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
For all ITV terminals in region receiving program offering 8	Hrs.	ARC	112
For all RO terminals in region receiving program offering 8	Hrs.	ARC	113
For all ITV terminals in region receiving program offering 9	Hrs.	ARC	114
For all RO terminals in region receiving program offering 9	Hrs.	ARC	115
c. Rocky Mountains			
For all ITV terminals in region receiving program offering 10	Hrs.	FRMS	116
For all RO terminals in region receiving program offering 10	Hrs.	FRMS	117
For all ITV terminals in region receiving program offering 11	Hrs.	FRMS	118
For all RO terminals in region receiving program offering 11	Hrs.	FRMS	119
For all ITV terminals in region receiving program offering 12	Hrs.	FRMS	120
For all RO terminals in region receiving program offering 12	Hrs.	FRMS	121
For all ITV terminals in region receiving program offering 13	Hrs.	FRMS	122
C. FIXED (w.r.t.#sites)/VARIABLE (w.r.t. programs broadcast)			
1. Development and production of materials used in program offerings			
a. Alaska-Program Offering 1			
Cost of pre-production research	$	NIE/Alaska RC	123
Script and creation costs	$	NIE/Alaska RC	124
Cost of studio & materials	$	NIE/Alaska RC	125

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Promotion expenses	$	NIE/Alaska RC	126
Utilization & Evaluation	$	NIE/Alaska RC	127
Other development and production costs including overhead and administration expense if not already included	$	NIE/Alaska RC	128
Estimate of expected yearly sales of program to sources outside of ESCD demonstration	$	NIE/Alaska RC	129
Expected useful lifetime of the program (perhaps controlled by technical obsolescense)	Yrs.	NIE/Alaska RC	130
Annualization factor (a function of 130, 004)	(No.)	Formula[2]	131
Present value factor for uniform stream of future revenue (a function of 130, 004)	(No.)	Formula[4]	132
b. Alaska-Program Offering 2			
Similar to 123 but for program offering 2	$	NIE/Alaska RC	133
Similar to 124 but for program offering 2	$	NIE/Alaska RC	134
Similar to 125 but for program offering 2	$	NIE/Alaska RC	135
Similar to 126 but for program offering 2	$	NIE/Alaska RC	136
Similar to 127 but for program offering 2	$	NIE/Alaska RC	137
Similar to 128 but for program offering 2	$	NIE/Alaska RC	138
Similar to 129 but for program offering 2	$	NIE/Alaska RC	139
Similar to 130 but for program offering 2	Yrs.	NIE/Alaska RC	140

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 131 but for program offering 2 (but in this case a function of 140, 004)	(No.)	Formula[2]	141
Similar to 132 but for program offering 2 (but in this case a function of 140, 004)	(No.)	Formula[4]	142
c. Alaska-Program Offering 3			
Similar to 123 but for program offering 3	$	NIE/Alaska RC	143
Similar to 124 but for program offering 3	$	NIE/Alaska RC	144
Similar to 125 but for program offering 3	$	NIE/Alaska RC	145
Similar to 126 but for program offering 3	$	NIE/Alaska RC	146
Similar to 127 but for program offering 3	$	NIE/Alaska RC	147
Similar to 128 but for program offering 3	$	NIE/Alaska RC	148
Similar to 129 but for program offering 3	$	NIE/Alaska RC	149
Similar to 130 but for program offering 3	Yrs.	NIE/Alaska RC	150
Similar to 131 but for program offering 3 (but in this case a function of 150 , 004)	(No.)	Formula[2]	151
Similar to 132 but for program offering 3 (but in this case a function of 150 , 004)	(No.)	Formula[4]	152
d. Alaska-Program Offering 4			
Similar to 123 but for program offering 4	$	NIE/Alaska RC	153
Similar to 124 but for program offering 4	$	NIE/Alaska RC	154

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 125 but for program offering 4	$	NIE/Alaska RC	155
Similar to 126 but for program offering 4	$	NIE/Alaska RC	156
Similar to 127 but for program offering 4	$	NIE/Alaska RC	157
Similar to 128 but for program offering 4	$	NIE/Alaska RC	158
Similar to 129 but for program offering 4	$	NIE/Alaska RC	159
Similar to 130 but for program offering 4	Yrs.	NIE/Alaska RC	160
Similar to 131 but for program offering 4 (but in this case a function of 160, 004)	(No.)	Formula[2]	161
Similar to 132 but for program offering 4 (but in this case a function of 160, 004)	(No.)	Formula[4]	162
e. Alaska-Program Offering 5			
Similar to 123 but for program offering 5	$	NIE/Alaska RC	163
Similar to 124 but for program offering 5	$	NIE/Alaska RC	164
Similar to 125 but for program offering 5	$	NIE/Alaska RC	165
Similar to 126 but for program offering 5	$	NIE/Alaska RC	166
Similar to 127 but for program offering 5	$	NIE/Alaska RC	167
Similar to 128 but for program offering 5	$	NIE/Alaska RC	168
Similar to 129 but for program offering 5	$	NIE/Alaska RC	169
Similar to 130 but for program offering 5	Yrs.	NIE/Alaska RC	170

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 131 but for program offering 5 (but in this case a function of 170, 004)	(No.)	Formula[2]	171
Similar to 132 but for program offering 5 (but in this case a function of 170, 004)	(No.)	Formula[4]	172
f. Appalachia-Program Offering 6			
Similar to 123 but for program offering 6	$	NIE/ARC	173
Similar to 124 but for program offering 6	$	NIE/ARC	174
Similar to 125 but for program offering 6	$	NIE/ARC	175
Similar to 126 but for program offering 6	$	NIE/ARC	176
Similar to 127 but for program offering 6	$	NIE/ARC	177
Similar to 128 but for program offering 6	$	NIE/ARC	178
Similar to 129 but for program offering 6	$	NIE/ARC	179
Similar to 130 but for program offering 6	Yrs.	NIE/ARC	180
Similar to 131 but for program offering 6 (but in this case a function of 180, 004)	(No.)	Formula[2]	181
Similar to 132 but for program offering 6 (but in this case a function of 180, 004)	(No.)	Formula[4]	182
g. Appalachia-Program Offering 7			
Similar to 123 but for program offering 7	$	NIE/ARC	183
Similar to 124 but for program offering 7	$	NIE/ARC	184

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 125 but for program offering 7	$	NIE/ARC	185
Similar to 126 but for program offering 7	$	NIE/ARC	186
Similar to 127 but for program offering 7	$	NIE/ARC	187
Similar to 128 but for program offering 7	$	NIE/ARC	188
Similar to 129 but for program offering 7	$	NIE/ARC	189
Similar to 130 but for program offering 7	Yrs.	NIE/ARC	190
Similar to 131 but for program offering 7 (but in this case a function of 190, 004)	(No.)	Formula[2]	191
Similar to 132 but for program offering 7 (but in this case a function of 190, 004)	(No.)	Formula[4]	192
h. Appalachia-Program Offering 8			
Similar to 123 but for program offering 8	$	NIE/ARC	193
Similar to 124 but for program offering 8	$	NIE/ARC	194
Similar to 125 but for program offering 8	$	NIE/ARC	195
Similar to 126 but for program offering 8	$	NIE/ARC	196
Similar to 127 but for program offering 8	$	NIE/ARC	197
Similar to 128 but for program offering 8	$	NIE/ARC	198
Similar to 129 but for program offering 8	$	NIE/ARC	199
Similar to 130 but for program offering 8	Yrs.	NIE/ARC	200

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 131 but for program offering 8 (but in this case a function of 200, 004)	(No.)	Formula[2]	201
Similar to 132 but for program offering 8 (but in this case a function of 200, 004)	(No.)	Formula[4]	202
i. Appalachia-Program Offering 9			
Similar to 123 but for program offering 9	$	NIE/ARC	203
Similar to 124 but for program offering 9	$	NIE/ARC	204
Similar to 125 but for program offering 9	$	NIE/ARC	205
Similar to 126 but for program offering 9	$	NIE/ARC	206
Similar to 127 but for program offering 9	$	NIE/ARC	207
Similar to 128 but for program offering 9	$	NIE/ARC	208
Similar to 129 but for program offering 9	$	NIE/ARC	209
Similar to 130 but for program offering 9	Yrs.	NIE/ARC	210
Similar to 131 but for program offering 9 (but in this case a function of 210, 004)	(No.)	Formula[2]	211
Similar to 132 but for program offering 9 (but in this case a function of 210, 004)	(No.)	Formula[4]	212
j. Rocky Mountains-Program Offering 10			
Similar to 123 but for program offering 10	$	NIE/FRMS	213
Similar to 124 but for program offering 10	$	NIE/FRMS	214

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 125 but for program offering 10	$	NIE/FRMS	215
Similar to 126 but for program offering 10	$	NIE/FRMS	216
Similar to 127 but for program offering 10	$	NIE/FRMS	217
Similar to 128 but for program offering 10	$	NIE/FRMS	218
Similar to 129 but for program offering 10	$	NIE/FRMS	219
Similar to 130 but for program offering 10	Yrs.	NIE/FRMS	220
Similar to 131 but for program offering 10 (but in this case a function of 220, 004)	(No.)	Formula[2]	221
Similar to 132 but for program offering 10 (but in this case a function of 220, 004)	(No.)	Formula[4]	222
k. Rocky Mountains-Program Offering 11			
Similar to 123 but for program offering 11	$	NIE/FRMS	223
Similar to 124 but for program offering 11	$	NIE/FRMS	224
Similar to 125 but for program offering 11	$	NIE/FRMS	225
Similar to 126 but for program offering 11	$	NIE/FRMS	226
Similar to 127 but for program offering 11	$	NIE/FRMS	227
Similar to 128 but for program offering 11	$	NIE/FRMS	228
Similar to 129 but for program offering 11	$	NIE/FRMS	229
Similar to 130 but for program offering 11	Yrs.	NIE/FRMS	230

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 131 but for program offering 11 (but in this case a function of 230, 004)	(No.)	NIE/FRMS	231
Similar to 132 but for program offering 11 (but in this case a function of 230, 004)	(No.)	NIE/FRMS	232
l. Rocky Mountains-Program Offering 12			
Similar to 123 but for program offering 12	$	NIE/FRMS	233
Similar to 124 but for program offering 12	$	NIE/FRMS	234
Similar to 125 but for program offering 12	$	NIE/FRMS	235
Similar to 126 but for program offering 12	$	NIE/FRMS	236
Similar to 127 but for program offering 12	$	NIE/FRMS	237
Similar to 128 but for program offering 12	$	NIE/FRMS	238
Similar to 129 but for program offering 12	$	NIE/FRMS	239
Similar to 130 but for program offering 12	Yrs.	NIE/FRMS	240
Similar to 131 but for program offering 12 (but in this case a function of 240, 004)	(No.)	Formula[2]	241
Similar to 132 but for program offering 12 (but in this case a function of 240, 004)	(No.)	Formula[4]	242
m. Rocky Mountains-Program Offering 13 (All costs summed over all materials distributed at all FRMS sites)			
Cost to FRMS sites to use materials transmitted, i.e. total price charged them	$	FRMS	243

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Cost of video tapes used for recording purposes	$	FRMS	244
Cost of required video tape equipment	$	FRMS	245
Expected useful lifetime of the video tapes	Yrs.	FRMS	246
Annualization factor (a function of 246, 004)	(No.)	Formula[2]	247
Expected useful lifetime of video tape equipment	Yrs.	FRMS	248
Annualization factor (a function of 248, 004)	(No.)	Formula[2]	249
2. Satellite and broadcast use			
Total operational (recurring) costs for satellite as a whole during demonstration year	$	NASA	250
Total operational (recurring) costs for up-link broadcast use during demonstration year on all channels of satellite	$	NASA	251
D. VARIABLE (w.r.t.#sites)/VARIABLE (w.r.t. programs broadcast)			
1. SBES related expenditures			
a. Site equipment operations - operational (recurring) costs of terminal operations			
Alaska (totals for entire region)			
ITV terminals and associated equipment.			
Labor costs during demonstration year (including shift rates where applicable)	$	Alaska RC	252
Utilities costs needed for equipment operations	$	Alaska RC	253

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Supplies and miscellaneous expenditures	$	Alaska RC	254
RO terminals and associated equipment			
Labor costs during demonstration year (including shift rates where applicable)	$	Alaska RC	255
Utilities costs needed for equipment operation	$	Alaska RC	256
Supplies and miscellaneous expenditures	$	Alaska RC	257
Appalachia (totals for entire region)			
Similar to 252 but for Appalachia	$	ARC	258
Similar to 253 but for Appalachia	$	ARC	259
Similar to 254 but for Appalachia	$	ARC	260
Similar to 255 but for Appalachia	$	ARC	261
Similar to 256 but for Appalachia	$	ARC	262
Similar to 257 but for Appalachia	$	ARC	263
Rocky Mountains (totals for entire region)			
Similar to 252 but for Rocky Mountains	$	FRMS	264
Similar to 253 but for Rocky Mountains	$	FRMS	265
Similar to 254 but for Rocky Mountains	$	FRMS	266
Similar to 255 but for Rocky Mountains	$	FRMS	267
Similar to 256 but for Rocky Mountains	$	FRMS	268
Similar to 257 but for Rocky Mountains	$	FRMS	269

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
b. Teacher time and support materials			
Alaska-Program Offering 1 (Early Childhood)			
Number of students involved at each site	(No.)	Local Sites	270,01-270,17
Number hours a student spent in program at each site (both in contact with satellite broadcast or materials from such broadcast and during normal instruction in this program offering not in contact with satellite broadcast or materials from such broadcast)	Hrs.	Local Sites	271,01-271,17
Number hours a student spent directly in contact with satellite broadcast or materials from such broadcast for the program offering during the demonstration year at each site	Hrs.	Local Sites and Alaska RC	272,01-272,17
Number teachint staff (teachers, aides, etc.) involved at each site	(No.)	Local Sites	273,01-273,17
Average salary of all teaching staff involved at all sites	$	Local Sites (Summed and averaged over all teachers involved in region.	274
Average fringe rate for all teaching staff involved	(No.) (Decimal)	Local Sites, either from analyses of all budget documents or by questionnaire.	275
Average ratio of length of teaching staff's working day to daily contact time with students for all teaching staff involved	(No.)	Local Sites, Questionnaire	276

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Average ratio of length of teaching staff's working year to length of students' year for all teaching staff involved.	(No.)	Local Sites Questionnaire	277
Average working year for teaching staff involved	Days	Local Sites Questionnaire	278
Average working hours per day for teaching staff involved	Hrs/Day	Local Sites Questionnaire	279
Total materials costs for program offering for each site.			
Directly related to or required by satellite	$	Local Sites Questionnaire	280,01-280,17
Not directly related to or required by satellite but needed for program offering	$	Local Sites Questionnaire	281,01-281,17
Alaska-Program Offering 2 (Oral Language Development)			
Similar to 270	(No.)	Local Sites	282,01-282,17
Similar to 271	Hrs.	Local Sites	283,01-283,17
Similar to 272	Hrs.	Local Sites	284,01-284,17
Similar to 273	(No.)	Local Sites	285,01-285,17
Similar to 274	$	Local Sites	286
Similar to 275	(No.)	Local Sites	287
Similar to 276	(No.)	Local Sites	288
Similar to 277	(No.)	Local Sites	289
Similar to 278	Days	Local Sites	290
Similar to 279	Hrs/Day	Local Sites	291
Similar to 280	$	Local Sites	292,01-292,17
Similar to 281	$	Local Sites (See 270-281 for above sources.)	293,01-293,17

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Alaska-Program Offering 3 (Health Education)			
Similar to 270	(No.)	Local Sites	294,01-294,17
Similar to 271	Hrs.	Local Sites	295,01-295,17
Similar to 272	Hrs.	Local Sites	296,01-296,17
Similar to 273	(No.)	Local Sites	297,01-297,17
Similar to 274	$	Local Sites	298
Similar to 275	(No.)	Local Sites	299
Similar to 276	(No.)	Local Sites	300
Similar to 277	(No.)	Local Sites	301
Similar to 278	Days	Local Sites	302
Similar to 279	Hrs/Day	Local Sites	303
Similar to 280	$	Local Sites	304,01-304,17
Similar to 281	$	Local Sites (See 270-281 for above sources.)	305,01-305,17
Alaska-Program Offering 4 (Teacher In-Service)			
Number teachers involved (as learners) at each site	(No.)	Local Sites	306,01-306,17
Number hours a teacher spent (as a learner) in program at each site (both in contact with satellite broadcast or materials from such broadcast and during normal instruction in this program offering not in contact with satellite broadcast or materials from such broadcast)	Hrs.	Local Sites	307,01-307,17
Number hours a teacher spent (as a learner) directly in contact with satellite broadcast or materials from such broadcast for this program	Hrs.	Local Sites and Alaska RC	308,01-308,17

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
offering during demonstration year at each site.			
Number of instructors involved at each site	(No.)	Local Sites	309,01-309,17
Number of this total who were paid a fee as consultants	(No.)	Local Sites	310,01-310,17
Average salary of all instructors not paid a fee as a consultants	$	Local Sites, Summed and Averaged over all such instructors involved in region.	311
Average fringe rate for all instructors not paid a fee as a consultant	(No.) (Decimal)	Local Sites, either from analyses of all budget documents or by questionnaire.	312
Average working year for all instructors not paid a fee as a consultant	Days	Local Sites, Questionnaire	313
Average working hours per day for all instructors not paid a fee as a consultant.	Hrs/Day	Local Sites, Questionnaire	314
Average fees and expenses paid to each consultant involved for entire in-service program at all sites	$	Local Sites, Questionnaire	315
Average expenses (travel, etc.) paid to each learner at all sites	$	Local Sites Questionnaire	316
Total materials costs for program offering for each site			
directly related to or required by satellite	$	Local Sites Questionnaire	317,01-317,17
not directly related to or required by satellite but needed for program offering	$	Local Sites Questionnaire	318,01-318,17

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Alaska-Program Offering 5 (Viewer Defined)			
No teacher related costs.			
Cost of all SBES support materials needed at each site and not included in D.1.C. (user coordination) below.	$	Local Sites Questionnaire	319,01-319,17
Appalachia-Program Offering 6 (Teacher In-Service, Elem. Reading)			
Similar to 306	(No.)	Local Sites	320,01-320,15
Similar to 307	Hrs.	Local Sites	321,01-321,15
Similar to 308	Hrs.	Local Sites	322,01-322,15
Similar to 309	(No.)	Local Sites	323,01-323,15
Similar to 310	(No.)	Local Sites	324,01-324,15
Similar to 311	$	Local Sites	325
Similar to 312	(No.)	Local Sites	326
Similar to 313	Days	Local Sites	327
Similar to 314	Hrs/Day	Local Sites	328
Similar to 315	$	Local Sites	329
Similar to 316	$	Local Sites	330
Similar to 317	$	Local Sites	331,01-331,15
Similar to 318	$	Local Sites (See 306-318 for above sources but in ARC.)	332,01-332,15
Appalachia-Program Offering 7 (Teacher In-Service, Elem. Career Ed.)			
Similar to 306	(No.)	Local Sites	333,01-333,15
Similar to 307	Hrs.	Local Sites	334,01-334,15
Similar to 308	Hrs.	Local Sites	335,01-335,15
Similar to 309	(No.)	Local Sites	336,01-336,15

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 310	(No.)	Local Sites	337,01-337,15
Similar to 311	$	Local Sites	338
Similar to 312	(No.)	Local Sites	339
Similar to 313	Days	Local Sites	340
Similar to 314	Hrs/Day	Local Sites	341
Similar to 315	$	Local Sites	342
Similar to 316	$	Local Sites	343
Similar to 317	$	Local Sites	344,01-344,15
Similar to 318	$	Local Sites (See 306-318 for above sources but in ARC.)	345,01-345,15
Appalachia-Program Offering 8 (Teacher In-Service, Jr. High Career Ed.)			
Similar to 306	(No.)	Local Sites	346,01-346,15
Similar to 307	Hrs.	Local Sites	347,01-347,15
Similar to 308	Hrs.	Local Sites	348,01-348,15
Similar to 309	(No.)	Local Sites	349,01-349,15
Similar to 310	(No.)	Local Sites	350,01-350,15
Similar to 311	$	Local Sites	351
Similar to 312	(No.)	Local Sites	352
Similar to 313	Days	Local Sites	353
Similar to 314	Hrs/Days	Local Sites	354
Similar to 315	$	Local Sites	355
Similar to 316	$	Local Sites	356
Similar to 317	$	Local Sites	357,01-357,15
Similar to 318	$	Local Sites (See 306-318 for above sources but in ARC.)	358,01-358,15

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Appalachia-Program Offering 9 (Teacher In-Service, Sr. High Career Ed.)			
Similar to 306	(No.)	Local Sites	359,01-359,15
Similar to 307	Hrs.	Local Sites	360,01-360,15
Similar to 308	Hrs.	Local Sites	361,01-361,15
Similar to 309	(No.)	Local Sites	362,01-362,15
Similar to 310	(No.)	Local Sites	363,01-363,15
Similar to 311	$	Local Sites	364
Similar to 312	(No.)	Local Sites	365
Similar to 313	Days	Local Sites	366
Similar to 314	Hrs/Day	Local Sites	367
Similar to 315	$	Local Sites	368
Similar to 316	$	Local Sites	369
Similar to 317	$	Local Sites	370,01-370,15
Similar to 318	$	Local Sites (See 306-318 for above sources but in ARC.)	371,01-371,15
Rocky Mountains-Program Offering 10 (Career Development, Jr.High)			
Similar to 270	(No.)	Local Sites	372,01-372,56
Similar to 271	Hrs.	Local Sites	373,01-373,56
Similar to 272	Hrs.	Local Sites	374,01-374,56
Similar to 273	(No.)	Local Sites	375,01-375,56
Similar to 274	$	Local Sites	376
Similar to 275	(No.)	Local Sites	377
Similar to 276	(No.)	Local Sites	378
Similar to 277	(No.)	Local Sites	379

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 278	Days	Local Sites	380
Similar to 279	Hrs/Day	Local Sites	381
Similar to 280	$	Local Sites	382,01-382,56
Similar to 281	$	Local Sites (See 270-281 for above source but in FRMS.)	383,01-383,56
Rocky Mountains-Program Offering 11 (Teacher In-Service)			
Similar to 306	(No.)	Local Sites	384,01-384,56
Similar to 307	Hrs.	Local Sites	385,01-385,56
Similar to 308	Hrs.	Local Sites	386,01-386,56
Similar to 309	(No.)	Local Sites	387,01-387,56
Similar to 310	(No.)	Local Sites	388,01-388,56
Similar to 311	$	Local Sites	389
Similar to 312	(No.)	Local Sites	390
Similar to 313	Days	Local Sites	391
Similar to 314	Hrs/Day	Local Sites	392
Similar to 315	$	Local Sites	393
Similar to 316	$	Local Sites	394
Similar to 317	$	Local Sites	395,01-395,56
Similar to 318	$	Local Sites (See 306-318 for above sources but in FRMS.)	396,01-396,56
Rocky Mountains-Program Offering 12 (General Audience)			
No teacher related costs.			

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Cost of all SBES support materials at each site needed and not included in D.1.c. (user coordination) below.	$	Local Sites Questionnaire	397,01-397,56
Rocky Mountains-Program Offering 13 (Materials Distribution) (all references to "Program" are to mean all those programs in which the materials distributed via the satellite were used.)			
Similar to 270	(No.)	Local Sites	398,01-398,24
Similar to 271	Hrs.	Local Sites	399,01-399,24
Similar to 272	Hrs.	Local Sites	400,01-400,24
Similar to 273	(No.)	Local Sites	401,01-401,24
Similar to 274	$	Local Sites	402
Similar to 275	(No.)	Local Sites	403
Similar to 276	(No.)	Local Sites	404
Similar to 277	(No.)	Local Sites	405
Similar to 278	Days	Local Sites	406
Similar to 279	Hrs/Day	Local Sites (See 270-279 for above source but in FRMS.)	407
Total materials costs for program offering(s) for each site			
Cost of materials provided via satellite	$	Local Sites Questionnaire	408,01-408,24
Cost of other materials not provided via satellite but directly related to or required by satellite	$	Local Sites Questionnaire	409,01-409,24
Costs of materials not directly provided by, related to, or required by the satellite but needed for program offering(s).	$	Local Sites Questionnaire	410,01-410,24

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
c. User Coordination			
Already shown as Variables 031 through 043.			
2. Non-SBES related expenditures			
a. Teacher time and support materials for program offerings 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 13.			
The necessary data have already been listed. Key to the allocation of costs such as these between D.1.b. and D.2.a. is the question of whether the satellite materials and programs are used in a supplementary, non-integrated manner with the remainder of the materials used in the program offering in question. If so, then the non-satellite time and materials cost would appear in D.2.a.; if not, then cost would appear in D.1.b.			
The remaining required data would be as follows:			
Alaska-Program Offering 5 (Viewer Defined)			
No teacher related costs			
Cost of all non-SBES support materials needed at each site as a result of the program and not included in D.1.c. above.	$	Local Sites Questionnaire	411,01-411,17
Rocky Mountains-Program Offering 12 (General Audience)			
No teacher related costs			
Cost of all non-SBES support materials needed at each site as a result of the program and not included in D.1.c. above.	$	Local Sites Questionnaire	412,01-412,56
b. Other costs			
Alaska			
Total other costs for program offering 1 at each site	$	Local Sites Questionnaire	413,01-413,17

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Total other costs for program offering 2 at each site	$	Local Sites Questionnaire	414,01-414,17
Total other costs for program offering 3 at each site	$	Local Sites Questionnaire	415,01-415,17
Total other costs for program offering 4 at each site	$	Local Sites Questionnaire	416,01-416,17
Total other costs for program offering 5 at each site	$	Local Sites Questionnaire	417,01-417,17
Appalachia			
Total other costs for program offering 6 at each site	$	Local Sites Questionnaire	418,01-418,15
Total other costs for program offering 7 at each site	$	Local Sites Questionnaire	419,01-419,15
Total other costs for program offering 8 at each site	$	Local Sites Questionnaire	420,01-420,15
Total other costs for program offering 9 at each site	$	Local Sites Questionnaire	421,01-421,15
Rocky Mountains			
Total other costs for program offering 10 at each site including such items as the cost of field trips and visits to local industries and businesses; however, teacher costs for these trips shall have been included in D.1.b. or D.2.a. above.	$	Local Sites Questionnaire	422,01-422,56
Total other costs for program offering 11 at each site	$	Local Sites Questionnaire	423,01-423,56
Total other costs for program offering 12 at each site	$	Local Sites Questionnaire	424,01-424,56
Total other costs for program offering 13 at each site	$	Local Sites Questionnaire	425,01-425,24

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
3. Value of learner time			
a. Alaska			
Program Offering 1 - Zero			
Program Offering 2 - Zero			
Program Offering 3 - Zero			
Program Offering 4			
Average salaries of all teachers involved (as learners) at each site.	$	Local Sites Summed and averaged over all such teachers involved in region	426,01-426,17
Average fringe rate for all teachers involved (as learners) at each site	(No.) (Decimal)	Local Sites Summed and averaged over all such teachers involved in region	427,01-427,17
Average working year for all such teachers at each site	Days	Local Sites Summed and averaged over all such teachers involved in region	428,01-428,17
Average working hours per day for all such teachers at each site	Hrs/Day	Local Sites Summed and averaged over all such teachers involved in region	429,01-429,17
Whether the in-service was considered to be in addition to normal inservice (430=1), or a direct replacement of normal inservice (430=0).	(No.)	Local Sites Questionnaire	430,01-430,17

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Other expenses (non-reimbursed) to learner			
Average round-trip travel time per teacher to and from in-service	Hrs.	Local Sites Questionnaire	431,01-431,17
Other travel costs (non-reimbursed) per teacher	$	Local Sites Questionnaire	432,01-432,17
Program Offering 5			
Approximate average salary of each member of audience	$	Alaska RC	433
Whether the viewing time was taken from normal working hours; if so, 434=1; if not, 434 = zero.	(No.)	Local Sites	434
Average audience size per showing	(No.)	Alaska RC	435
Total viewing time per viewer over entire demonstration (viewer who saw every broadcast)	Hrs.	Alaska RC	436
b. Appalachia			
Program Offering 6			
Similar to 426	$	Local Sites Questionnaire	437,01-437,15
Similar to 427	(No.)	Local Sites Questionnaire	438,01-438,15
Similar to 428	Days	Local Sites Questionnaire	439,01-439,15
Similar to 429	Hrs/Day	Local Sites Questionnaire	440,01-440,15
Similar to 430	(No.)	Local Sites Questionnaire	441,01-441,15
Similar to 431	Hrs.	Local Sites Questionnaire	442,01-442,15

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Similar to 432	$	Local Sites Questionnaire	443,01-443,15
Program Offering 7			
Similar to 426	$	Local Sites Questionnaire	444,01-444,15
Similar to 427	(No.)	Local Sites Questionnaire	445,01-445,15
Similar to 428	Days	Local Sites Questionnaire	446,01-446,15
Similar to 429	Hrs/Day	Local Sites Questionnaire	447,01-447,15
Similar to 430	(No.)	Local Sites Questionnaire	448,01-448,15
Similar to 431	Hrs.	Local Sites Questionnaire	449,01-449,15
Similar to 432	$	Local Sites Questionnaire	450,01-450,15
Program Offering 8			
Similar to 426	$	Local Sites Questionnaire	451,01-451,15
Similar to 427	(No.)	Local Sites Questionnaire	452,01-452,15
Similar to 428	Days	Local Sites Questionnaire	453,01-453,15
Similar to 429	Hrs/Day	Local Sites Questionnaire	454,01-454,15
Similar to 430	(No.)	Local Sites Questionnaire	455,01-455,15
Similar to 431	Hrs.	Local Sites Questionnaire	456,01-456,15
Similar to 432	$	Local Sites Questionnaire	457,01-457,15

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Program Offering 9			
Similar to 426	$	Local Sites Questionnaire	458,01-458,15
Similar to 427	(No.)	Local Sites Questionnaire	459,01-459,15
Similar to 428	Days	Local Sites Questionnaire	460,01-460,15
Similar to 429	Hrs/Day	Local Sites Questionnaire	461,01-461,15
Similar to 430	(No.)	Local Sites Questionnaire	462,01-462,15
Similar to 431	Hrs.	Local Sites Questionnaire	463,01-463,15
Similar to 432	$	Local Sites Questionnaire	464,01-464,15
c. Rocky Mountains			
Program Offering 10 - Zero			
Program Offering 11			
Similar to 426	$	Local Sites Questionnaire	465,01-465,56
Similar to 427	(No.)	Local Sites Questionnaire	466,01-466,56
Similar to 428	Days	Local Sites Questionnaire	467,01-467,56
Similar to 429	Hrs/Day	Local Sites Questionnaire	468,01-468,56
Similar to 430	(No.)	Local Sites Questionnaire	469,01-469,56
Similar to 431	Hrs.	Local Sites Questionnaire	470,01-470,56
Similar to 432	$	Local Sites Questionnaire	471,01-471,56

FIGURE VIII-2 (CONT.)

DATA REQUIRED FOR EACH COST CATEGORY	UNIT	SOURCE	VARIABLE NO.
Program Offering 12			
Similar to 433	$	Local Sites Questionnaire	472
Similar to 434	(No.)	Local Sites Questionnaire	473
Similar to 435	(No.)	Local Sites Questionnaire	474
Similar to 436	Hrs.	Local Sites Questionnaire	475
Program Offering 13 - Zero			

NOTES

1. Estimate based upon prevailing interest rate structures in nation at time cost study is conducted.

2. Formula: $a(r,n) = (r(1 + r)^n)/((1 + r)^n - 1)$

   where: a is the annualization factor;
   r is the interest or social discount rate expressed as a decimal between 0.00 and 1.00; and
   n is the expected useful lifetime.

3. The sum of variable 015 through 027 inclusive equals variable 008.

4. Formula: $p(r,n) = \sum_{i=1}^{n} (1/(1 + r)^i)$ or $= \dfrac{(1 + r)^n - 1}{r(1 + r)^n}$

   where: r is the interest or social discount rate expressed as a decimal between 0.00 and 1.00; and
   n is the number of periods for which the uniform revenue flow is expected.

KEY TO ABBREVIATIONS AND SYMBOLOGY IN FIGURE VIII-3

- The 3 digit numbers used throughout refer directly to variables number 001 through 475 listed in Figure 3 (Data Required for Each Cost Category).

- The symbol "*" indicates multiplication.

- The symbol "/" indicates division.

- The symbol "$\sum_{1}^{n}$(VN,i)" is a shorthand representation for the following sum: (VN,1)+(VN,2)+...+(VN,n); where "VN" indicates a specific variable number listed in Figure 3; "n" represents the number of sites within the region for which data on variable number "VN" have been individually collected; and "i" refers to a specific site.

- The symbol "$\sum_{1}^{n}$((VN1,i)*(VN2,i))" is a shorthand representation for the following sum: [(VN1,1)*(VN2,1)]+[(VN1,2)*(VN2,2)]+...+[(VN1,n)*(VN2,n)]; where "VN1" and "VN2" indicate two different variable numbers listed in Figure 3; "n" represents the number of sites within the region for which data on variable numbers "VN1" and "VN2" have been individually collected; and "i" refers to a specific site.

- The symbol "$\sum_{1}^{n}$((VN1,i)-(VN2,i))" is a shorthand representation for the following sum: [(VN1,1)-(VN2,1)]+[(VN1,2)-(VN2,2)]+...+[(VN1,n)-(VN2,n)]; where "VN1" and "VN2" indicate two different variable numbers listed in Figure 3; "n" represents the number of sites within the region for which data on variable numbers "VN1" and "VN2" have been individually collected; and "i" refers to a specific site.

- The symbol "$\sum_{1}^{n}$((VN1,i)*((VN2,i)-(VN3,i)))" is a shorthand representation for the following sum: {(VN1,1)*[(VN2,1)-(VN3,1)]}+{(VN1,2)*[(VN2,2)-(VN3,2)]}+...+{(VN1,n)*[(VN2,n)-(VN3,n)]}; where "VN1", "VN2", and "VN3" indicate three different variable nunbers listed in Figure 3; "n" represents the number of sites within the region for which data on variable numbers "VN1", "VN2", and "VN3" have been individually collected; and "i" refers to a specific site.

- The symbol "$\sum_{1}^{n}$((((VN1,i)*(1.0+(VN2,i)))/((VN3,i)*(VN4,i)))*(VN5,i))" is a shorthand representation of the following sum:

$$\frac{(VN1,1)\ast[1.0+(VN2,1)]}{(VN3,1)\ast(VN4,1)}\ast(VN5,1)+\frac{(VN1,2)\ast[1.0+(VN2,2)]}{(VN3,2)\ast(VN4,2)}\ast(VN5,2)+\ldots$$

$$+\frac{(VN1,n)\ast[1.0+(VN2,n)]}{(VN3,n)\ast(VN4,n)}\ast(VN5,n)$$

where "VN1", "VN2", "VN3", "VN4", and "VN5" indicate five different variable numbers listed in Figure 3; "n" represents the number of sites within the region for which data on variable numbers "VN1", "VN2", "VN3", "VN4", and "VN5" have been individually collected; and "i" refers to a specific site.

- The abbreviations "T1" through "T19" inclusive are defined as follows:

T1 = [(001*003)*005+(008/007)*006+(009+010)*012+013+014]
T2 = (015+016+017+018+019)
T3 = [028-(031+032+033+034+035)]
T4 = (020+021+022+023)
T5 = [029-(036+037+038+039)]
T6 = (024+025+026+027)
T7 = [030-(040+041+042+043)]
T8 = (098+100+102+104+106)
T9 = [(044*045)*047+(048*050)]
T10 = (099+101+103+105+107)
T11 = [(051*052)*054+(055*057)]
T12 = (108+110+112+114)
T13 = [(058*059)*061+(062*064)]
T14 = (109+111+113+115)
T15 = [(065*066)*068+(069*071)]
T16 = (116+118+120+122)
T17 = [(072*073)*075+(076*078)]
T18 = (117+119+121)
T19 = [(079*080)*082+(083*085)]

FIGURE VIII-3

PROGRAM OFFERING 1 - Early Childhood, Alaska

$$A1 = (015/008)*((001*003)*005+(008/007)*006+(009+010)*012+013+014)$$
$$= (015/008)*T1$$

$$A2 = (015/(015+016+017+018+019))*(028-(031+032+033+034+035))$$
$$= (015/T2)*T3$$

$$B1 = ((098/(098+100+102+104+106))*((044*045)*047+(048*050)))+$$
$$((099/(099+101+103+105+107))*((051*052)*054+(055*057)))$$
$$= ((098/(T8))*(T9))+((099/(T10))*(T11))$$

$$B2 = (098/(T8))*(086+087)+(099/(T10))*(088+089)$$

$$C1 = ((123+124+125+126+127+128)-(129*132))*131$$

$$C2 = (015)*((250+251)/007)$$

$$D1 = (\overbrace{(098/(T8))*(252+253+254)+(099/(T10))*(255+256+257)}^{D.1.a.})+\overbrace{(031)}^{D.1.c.}$$

$$\text{D.1.b.}\left[\begin{array}{l}(((274)*(1.0+(275))*(276)*(277))/((278)*(279)))*(\sum_{1}^{17}(273,i))*\\((\sum_{1}^{17}((270,i)*(272,i)))/(\sum_{1}^{17}(270,i)))+(\sum_{1}^{17}(280,i))+(((274)*(1.0+(275))*\\(276)*(277))/((278)*(279)))*(\sum_{1}^{17}(273,i))*((\sum_{1}^{17}((270,i)*((271,i)-\\(272,i))))/(\sum_{1}^{17}(270,i)))+(\sum_{1}^{17}(281,i))\end{array}\right.$$

optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable}) + (\sum_{1}^{17}(413,i))$$

$$D3 = \text{ZERO}$$

PROGRAM OFFERING 2 - Oral Language Development, Alaska

$$A1 = (016/008)*T1$$

$$A2 = (016/T2)*T3$$

$$B1 = ((100/(T8))*(T9))+((101/(T10))*(T11))$$

$$B2 = (100/(T8))*(086+087)+(101/(T10))*(088+089)$$

$$C1 = ((133+134+135+136+137+138)-(139*142))*141$$

$$C2 = (016)*((250+251)/007)$$

$$D1 = (\overbrace{(100/(T8))*(252+253+254)+(101/(T10))*(255+256+257)}^{\text{D.1.a.}})+\overbrace{(032)}^{\text{D.1.c.}}+$$

$$\text{D.1.b.}\left[\begin{array}{l} (((286)*(1.0+(287))*(288)*(289))/((290)*(291)))*(\sum_{1}^{17}(285,i))* \\ ((\sum_{1}^{17}((282,i)*(284,i)))/(\sum_{1}^{17}(282,i)))+(\sum_{1}^{17}(292,i))+\underline{(((286)*(1.0+(287))*} \\ \underline{(288)*(289))/((290)*(291)))*(\sum_{1}^{17}(285,i))*((\sum_{1}^{17}((282,i)*((283,i)-} \\ (284,i))))/(\sum_{1}^{17}(282,i)))+(\sum_{1}^{17}(293,i)) \end{array}\right.$$

optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable}) + (\sum_{1}^{17}(414,i))$$

$$D3 = ZERO$$

PROGRAM OFFERING 3 - Health Education, Alaska

$A1 = (017/008)*T1$

$A2 = (017/T2)*T3$

$B1 = ((102/(T8))*(T9))+((103/(T10))*(T11))$

$B2 = (102/(T8))*(086+087)+(103/(T10))*(088+089)$

$C1 = ((143+144+145+146+147+148)-(149*152))*151$

$C2 = (017)*((250+251)/007)$

$$D1 = (\overbrace{(102/(T8))*(252+253+254)+(103/(T10))*(255+256+257)}^{D.1.a.})+\overbrace{(033)}^{D.1.c.}+$$

D.1.b, —

$(((298)*(1.0+(299))*(300)*(301))/((302)*(303)))*(\sum_{1}^{17}(297,i))*$

$((\sum_{1}^{17}((294,i)*(296,i)))/(\sum_{1}^{17}(294,i)))+(\sum_{1}^{17}(304,i))+(((298)*(1.0+(299))*$

$(300)*(301))/((302)*(303)))*(\sum_{1}^{17}(297,i))*((\sum_{1}^{17}((294,i)*((295,i)-$

$(296,i))))/(\sum_{1}^{17}(294,i)))+(\sum_{1}^{17}(305,i))$

optional in D1, may appear in D2 if satellite is not integrated into curriculum

$D2 =$ (optional total shown in D1, if applicable) + $(\sum_{1}^{17}(415,i))$

D3 - ZERO

PROGRAM OFFERING 4 - Teacher In-Service, Alaska

$$A1 = (018/008)*T1$$

$$A2 = (018/T2)*T3$$

$$B1 = ((104/(T8))*(T9))+((105/(T10))*(T11))$$

$$B2 = (104/(T8))*(086+087)+(105/(T10))*(088+089)$$

$$C1 = ((153+154+155+156+157+158)-(159*162))*161$$

$$C2 = (018)*((250+251)/007)$$

$$D1 = (\overbrace{(104/(T8))*(252+253+254)+(105/(T10))*(255+256+257)}^{D.1.a.})+\overbrace{(034)}^{D.1.c.}+$$

$$(((311)*(1.0+(312)))/((313)*(314)))*(\sum_{1}^{17}((309,i)-(310,i)))*((\sum_{1}^{17}(306,i)*$$

$$(308,i)))/(\sum_{1}^{17}(306,i)))+(((\sum_{1}^{17}((306,i)*(308,i)))/(\sum_{1}^{17}(306,i)))/((\sum_{1}^{17}((306,i)*$$

$$(307,i)))/(\sum_{1}^{17}(306,i))))*(((315)*(\sum_{1}^{17}(310,i)))+((316)*(\sum_{1}^{17}(306,i))))+$$

$$(\sum_{1}^{17}(317,i))+$$

$$(((311)*(1.0+(312)))/((313)*(314)))*(\sum_{1}^{17}((309,i)-(310,i)))*((\sum_{1}^{17}((306,i)*$$

$$((307,i)-(308,i))))/(\sum_{1}^{17}(306,i)))+(((\sum_{1}^{17}((306,i)*((307,i)-(308,i))))/$$

$$(\sum_{1}^{17}(306,i)))/((\sum_{1}^{17}((306,i)*(307,i)))/(\sum_{1}^{17}(306,i))))*(((315)*(\sum_{1}^{17}(310,i)))+$$

$$((316)*(\sum_{1}^{17}(306,i))))+(\sum_{1}^{17}(318,i))$$

D.1.b. optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{17}(416,1))$$

$$D3 = (\sum_{1}^{17}((((426,i)*(1.0+(427,i)))/((428,i)*(429,i)))*(430,i)))+(\sum_{1}^{17}(431,i))+$$

$$(\sum_{1}^{17}(432,i))$$

PROGRAM OFFERING 5 - Viewer Defined (Native Magazine), Alaska

$$A1 = (019/008)*T1$$

$$A2 = (019/T2)*T3$$

$$B1 = ((106/(T8))*(T9))+((107/(T10))*(T11)$$

$$B2 = (106/(T8))*(086+087)+(107/(T10))*(088+089)$$

$$C1 = ((163+164+165+166+167+168)-(169*172))*171$$

$$C2 = (019)*((250+251)/(007)$$

$$D1 = (\overbrace{(106/(T8))*(252+253+254)+(107/(T10))*(255+256+257)}^{D.1.a.})+\overbrace{(035)}^{D.1.c.}+ \underbrace{(\sum_{1}^{17}(319,i))}_{D.1.b.}$$

$$D2 = (\sum_{1}^{17}(411,i))+(\sum_{1}^{17}(417,i))$$

$$D3 = ((433)/(40.0*52.0))*(435)*(436)*(434)$$

PROGRAM OFFERING 6 - Teacher Training (Elementary Reading), Appalachia

$$A1 = (020/008)*T1$$

$$A2 = (020/\underline{(020+021+022+023)})*\underline{(029-(036+037+038+039))}$$

$$(020/\underline{T4})*\underline{T5}$$

$$B1 = ((108/\underline{(108+110+112+114)})*(\underline{(058*059)}*061+\underline{(062*064)}))+((109/\underline{(109+111+113+115)})*$$

$$(\underline{(065*066)*068+(069*071)}))=((108/(T12))*(T13))+((109/(T14))*(T15))$$

$$B2 = (108/(T12))*(090+091)+(109/(T14))*(092+093)$$

$$C1 = ((173+174+175+176+177+178)-(179*182))*181$$

$$C2 = (020)*((250+251)/007)$$

$$D1 = (\overbrace{(108/(T12))*(258+259+260)+(109/(T14))*(261+262+263)}^{D.1.a.})+\overbrace{(036)}^{D.1.c.}+$$

$$(((325)*(1.0+(326)))/((327)*(328)))*(\sum_{1}^{15}((323,i)-(324,i)))*((\sum_{1}^{15}((320,i)*$$

$$(322,i)))/(\sum_{1}^{15}(320,i)))+(((\sum_{1}^{15}((320,i)*(322,i)))/(\sum_{1}^{15}(320,i)))/((\sum_{1}^{15}((320,i)*$$

$$(321,i)))/(\sum_{1}^{15}(320,i))))*(((329)*(\sum_{1}^{15}(324,i)))+((330)*(\sum_{1}^{15}(320,i))))+(\sum_{1}^{15}(331,i))+$$

$$(((325)*(1.0+(326)))/((327)*(328)))*(\sum_{1}^{15}((323,i)-(324,i)))*((\sum_{1}^{15}((320,i)*$$

$$((321,i)-(322,i))))/(\sum_{1}^{15}(320,i)))+(((\sum_{1}^{15}((320,i)*((321,i)-(322,i))))/(\sum_{1}^{15}(320,i)))/$$

$$((\sum_{1}^{15}((320,i)*(321,i)))/(\sum_{1}^{15}(320,i))))*(((329)*(\sum_{1}^{15}(324,i)))+((330)*$$

$$(\sum_{1}^{15}(320,i))))+(\sum_{1}^{15}(332,i))$$

D.1.b. Optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{15}(418,i))$$

$$D3 = (\sum_{1}^{15}((((437,i)*(1.0+(438,i)))/((439,i)*(440,i)))*(441,i)))+(\sum_{1}^{15}(442,i))+$$

$$(\sum_{1}^{15}(443,i))$$

PROGRAM OFFERING 7 - Teacher Training (Elementary Career Education), Appalachia

$A1 = (021/008)*T1$

$A2 = (021/T4)*T5$

$B1 = ((110/(T12))*(T13))+((111/(T14))*(T15))$

$B2 = (110/(T12))*(090+091)+(111/(T14))*(092+093)$

$C1 = ((183+184+185+186+187+188)-(189*192)*191$

$C2 = (021)*((250+251)/007)$

$$D1 = (\overbrace{(110/(T12))*(258+259+260)+(111/(T14))*(261+262+263)}^{D.1.a.})+\overbrace{(037)}^{D.1.c.}+$$

$(((338)*(1.0+(339)))/((340)*(341)))*(\sum_{1}^{15}((336,i)-(337,i)))*((\sum_{1}^{15}((333,i)*$

$(335,i)))/(\sum_{1}^{15}(333,i)))+(((\sum_{1}^{15}((333,i)*(335,i)))/(\sum_{1}^{15}(333,i)))/((\sum_{1}^{15}((333,i)*$

$(334,i)))/(\sum_{1}^{15}(333,i))))*(((342)*(\sum_{1}^{15}(337,i)))+((343)*(\sum_{1}^{15}(333,i))))+(\sum_{1}^{15}(344,i))+$

$(((338)*(1.0+(339)))/((340)*(341)))*(\sum_{1}^{15}((336,i)-(337,i)))*((\sum_{1}^{15}((333,i)*$

$((334,i)-(335,i))))/(\sum_{1}^{15}(333,i)))+(((\sum_{1}^{15}((333,i)*((334,i)-(335,i))))/(\sum_{1}^{15}(333,i)))/$

$((\sum_{1}^{15}((333,i)*(334,i)))/(\sum_{1}^{15}(333,i))))*(((342)*(\sum_{1}^{15}(337,i)))+((343)*$

$(\sum_{1}^{15}(333,i))))+(\sum_{1}^{15}(345,i))$

D.1.b. optional in D1, may appear in D2 if satellite is not inteprated into curriculum

$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{15}(419,i))$

$D3 = (\sum_{1}^{15}((((444,i)*(1.0+(445,i)))/((446,i)*(447,i)))*(448,i)))+(\sum_{1}^{15}(449,i))+$

$(\sum_{1}^{15}(450,i))$

PROGRAM OFFERING 8 - Teacher Training (Junior High Career Education), Appalachia

$A1 = (022/008)*T1$

$A2 = (022/T4)*T5$

$B1 = ((112/(T12))*(T13))+((113/(T14))*(T15))$

$B2 = (112/(T12))*(090+091)+(113/(T14))*(092+093)$

$C1 = ((193+194+195+196+197+198)-(199*202))*201$

$C2 = (022)*((250+251)/007)$

$$D1 = \overbrace{((112/(T12))*(258+259+260)+(113/(T14))*(261+262+263))}^{D.1.a.}+\overbrace{(038)}^{D.1.c.}+$$

$$(((351)*(1.0+(352)))/((353)*(354)))*(\sum_{1}^{i15}((349,i)-(350,i)))*((\sum_{1}^{15}((346,i)*$$

$$(348,i)))/(\sum_{1}^{15}(346,i)))+(((\sum_{1}^{15}((346,i)*(348,i)))/(\sum_{1}^{15}(346,i)))/((\sum_{1}^{15}((346,i)$$

$$*(347,i)))/(\sum_{1}^{15}(346,i))))*(((355)*(\sum_{1}^{15}(350,i)))+((356)*(\sum_{1}^{15}(346,i))))+(\sum_{1}^{15}(357,i))+$$

$$(((351)*(1.0+(352)))/((353)*(354)))*(\sum_{1}^{15}((349,i)-(350,i)))*((\sum_{1}^{15}((346,i)*$$

$$((347,i)-(348,i))))/(\sum_{1}^{15}(346,i)))+(((\sum_{1}^{15}((346,i)*((347,i)-(348,i)))))/(\sum_{1}^{15}(346,i)))/$$

$$((\sum_{1}^{15}((346,i)*(347,i)))/(\sum_{1}^{15}(346,i))))*(((355)*(\sum_{1}^{15}(350,i)))+((356)*(\sum_{1}^{15}(346,i))))+$$

$$(\sum_{1}^{15}(358,i))$$

D.1.b. optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{15}(420,i))$$

$$D3 = (\sum_{1}^{15}((((451,i)*(1.0+(452,i)))/((453,i)*(454,i)))*(455,i)))*(\sum_{1}^{15}(456,i))+$$

$$(\sum_{1}^{15}(457,i))$$

PROGRAM OFFERING 9 - Teacher Training (Senior High Career Education), Appalachia

$A1 = (023/008)*T1$

$A2 = (023/T4)*T5$

$B1 = ((114/(T12))*(T13))+((115/(T14))*(T15))$

$B2 = (114/(T12))*(090+091)+(115/(T14))*(092+093)$

$C1 = ((203+204+205+206+207+208)-(209*212))*211$

$C2 = (023)*((250+251)/007)$

$$
\begin{aligned}
D1 = {} & \overbrace{((114/(T12))*(258+259+260)+(115/(T14))*(261+262+263))}^{D.1.a.}+\overbrace{(039)}^{D.1.c.}+\\
& (((364)*(1.0+(365)))/((366)*(367)))*(\sum_{1}^{15}((362,i)-(363,i)))*((\sum_{1}^{15}((359,i)*\\
& (361,i)))/(\sum_{1}^{15}(359,i)))+(((\sum_{1}^{15}((359,i)*(361,i)))/(\sum_{1}^{15}(359,i)))/((\sum_{1}^{15}((359,i)*\\
& (360,i)))/(\sum_{1}^{15}(359,i))))*(((368)*(\sum_{1}^{15}(363,i)))+((369)*(\sum_{1}^{15}(359,i))))+(\sum_{1}^{15}(370,i))+\\
& (((364)*(1.0+(365)))/((366)*(367)))*(\sum_{1}^{15}((362,i)-(363,i)))*((\sum_{1}^{15}((359,i)*((360,i)-\\
& (361,i))))/(\sum_{1}^{15}(359,i)))+(((\sum_{1}^{15}((359,i)*((360,i)-(361,i))))/(\sum_{1}^{15}(359,i)))/\\
& ((\sum_{1}^{15}((359,i)*(360,i)))/(\sum_{1}^{15}(359,i))))*(((368)*(\sum_{1}^{15}(363,i)))+((369)*\\
& (\sum_{1}^{15}(359,i))))+(\sum_{1}^{15}(371,i))
\end{aligned}
$$

D.1.b.–optional in D1, may appear in D2 of satellite is not integrated into curriculum

$D2 = \{\text{optional total shown in D1, if applicable})+(\sum_{1}^{15}(421,i))$

$$
\begin{aligned}
D3 = {} & (\sum_{1}^{15}((((458,i)*(1.0+(459,i)))/((460,i)*(461,i)))*(462,i)))+(\sum_{1}^{15}(463,i))+\\
& (\sum_{1}^{15}(464,i))
\end{aligned}
$$

PROGRAM OFFERING 10 - Junior High Career Development, Rocky Mountains

A1 = (024/008)*T1

A2 = (024/(024+025+026+027)*(030-(040+041+042+043))
+(024/T6)*T7

B1 = ((116/(116+118+120+122))*((072*073)*075+(076*078)))+((117/(117+119+121))*
((079*080)*082+(083*085)))=((116/(T16))*(T17))+((117/(T18))*(T19))

B2 = (116/(T16))*(094+095)+(117/(T18))*(096+097)

C1 = ((213+214+215+216+217+218)-(219*222))*221

C2 = (024*((250+251)/007

D.1.a. D.1.c.

D1 = ((116/(T16))*(264+265+266)+(117/(T18))*(267+268+269))+(040)+

D.1.b. (((376)*(1.0+(377))*(378)*(379))/((380)*(381)))*($\sum_{1}^{56}$(375,i))*(($\sum_{1}^{56}$((372,i)*
(374,i)))/($\sum_{1}^{56}$(372,i)))+($\sum_{1}^{56}$(382,i))+(((376)*(1.0+(377))*(378)*(379))/
((380)*(381)))*($\sum_{1}^{56}$(375,i))*(($\sum_{1}^{56}$((372,i)*((373,i)-(374,i))))/($\sum_{1}^{56}$(372,i)))+
($\sum_{1}^{56}$(383,i))

optional in D1, may appear in D2 if satellite is not integrated into curriculum

D2 = (optional total shown in D1, if applicable)+($\sum_{1}^{56}$(422,i))

D3 = ZERO

PROGRAM OFFERING 11 - Teacher In-Service, Rocky Mountains

A1 = (025/008)*T1

A2 = (025/T6)*T7

B1 = ((118/(T16))*(T17))+((119/(T18))*(T19))

B2 = (118/(T16))*(094+095)+(119/(T18))*(096+097)

C1 = ((223+224+225+226+227+228)-(229*232))*231

C2 = (025)*((250+251)/007)

$$D1 = (\overbrace{(118/(T16))*(264+265+266)+(119/(T18))*(267+268+269)}^{D.1.a.})+\overbrace{(041)}^{D.1.c.}+$$

$$(((389)*(1.0+(390)))/((391)*(392)))*(\sum_{1}^{56}((387,i)-(388,i)))*((\sum_{1}^{56}((384,i)*$$

$$(386,i)))/(\sum_{1}^{56}(384,i)))+(((\sum_{1}^{56}((384,i)*(386,i)))/(\sum_{1}^{56}(384,i)))/((\sum_{1}^{56}((384,i)*$$

$$(385,i)))/(\sum_{1}^{56}(384,i))))*(((393)*(\sum_{1}^{56}(388,i)))+((394)*(\sum_{1}^{56}(384,i))))+(\sum_{1}^{56}(395,i))+$$

$$(((389)*(1.0+(390)))/((391)*(392)))*(\sum_{1}^{56}((387,i)-(388,i)))*((\sum_{1}^{56}((384,i)*$$

$$((385,i)-(386,i))))/(\sum_{1}^{56}(384,i)))+(((\sum_{1}^{56}((384,i)*((385,i)-(386,i))))/$$

$$(\sum_{1}^{56}(384,i)))/((\sum_{1}^{56}((384,i)*(385,i)))/(\sum_{1}^{56}(384,i))))*(((393)*(\sum_{1}^{56}(388,i)))+$$

$$((394)*(\sum_{1}^{56}(384,i))))+(\sum_{1}^{56}(396,i))$$

D.1.b. optional in D1, may appear in D2 if satellite is not integrated into curriculum

$$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{56}(423,i))$$

$$D3 = (\sum_{1}^{56}((((465,i)*(1.0+(466,i)))/((467,i)*(468,i)))*(469,i)))+(\sum_{1}^{56}(470,i))+(\sum_{1}^{56}(471,i))$$

PROGRAM OFFERING 12 - General Audience, Rocky Mountains

$$A1 = (026/008)*T1$$

$$A2 = (026/T6)*T7$$

$$B1 = ((120/(T16))*(T17))+((121/(T18))*(T19))$$

$$B2 = (120/(T16))*(094+095)+(121/(T18))*(096+097)$$

$$C1 = ((233+234+235+236+237+238)-(239*242))*241$$

$$C2 = (026)*((250+251)/007)$$

$$D1 = ((\overbrace{120/(T16))*(264+265+266)+(121/(T18))*(267+268+269)}^{D.1.a.})+(\overbrace{042}^{D.1.c.})+(\underbrace{\sum_{1}^{56}(397,i)}_{D.1.b.}))$$

$$D2 = (\sum_{1}^{56}(412,i))+(\sum_{1}^{56}(424,i))$$

$$D3 = ((472)/(40.0*52.0))*(474)*(475)*(473)$$

PROGRAM OFFERING 13 - Materials Distribution, Rocky Mountains

$A1 = (027/008)*T1$

$A2 = (027/T6)*T7$

$B1 = ((122/(T16))*(T17))$

$B2 = (122/(T16))*(094+095)$

$C1 = ((243+244)*247)+(245*249)$

$C2 = (027)*((250+251)/007)$

$$D1 = (\overbrace{(122/(T16))*(264+265+266)}^{D.1.a.})+(\overbrace{043}^{D.1.c.})+$$

$$(((402)*(1.0+(403))*(404)*(405))/((406)*(407)))*(\sum_{1}^{24}(401,i))*((\sum_{1}^{24}((398,i)*$$

$$(400,i)))/(\sum_{1}^{24}(398,i)))+(\sum_{1}^{24}(408,i))+(\sum_{1}^{24}(409,i))+$$

$$(((402)*(1.0+(403))*(404)*(405))/((406)*(407)))*(\sum_{1}^{24}(401,i))*((\sum_{1}^{24}((398,i)*$$

$$((399,i)-(400,i))))/(\sum_{1}^{24}(398,i)))+(\sum_{1}^{24}(410,i))$$

D.1.b: optional in D1, may appear in D2 if satellite is not integrated into curriculum

$D2 = (\text{optional total shown in D1, if applicable})+(\sum_{1}^{24}(425,i))$

$D3 = \text{ZERO}$

PCI could begin data collection immediately for the cost analysis; however, because the cost analysis is not immediately needed, PCI plans to validate the model by testing it in collaboration with the regional contractors, calibrate the data from the three regions, and then prepare a refined model for computer manipulation. The cost analysis model will be available to the regional contractors and DHEW/NIE for answering questions of their own.

The sources of the data will be as follows:

1. From NASA and DHEW -- Costs of satellite capability and operation plus use of the satellite for applications not related to ESCD.

2. Regional Contractors -- Costs for broadcasting, program development and production, and user coordination. In addition, any information about costs at the 88 ESCD sites available through the regional contractors will be obtained through them with appropriate validation but minimizing intrusiveness of PCI at the sites and minimizing redundant data collection.

3. Receiving Sites -- PCI will collect information from 100% of the 88 receiving sites, using the site coordinator as much as possible for information not already available from regional contractors. The cost information will include:

   D1 -- Satellite Related Costs for Equipment, Teachers, and Materials
   D2 -- Non-Satellite Related Costs for the Same Course
   D3 -- The Value of Learner Time in Courses Such as Teacher Training For Adult Learners.

Information about alternative programs, different from what was done in the demonstration, will also have to come from the 88 sites. The PCI approach concentrates on the program used prior to the demonstration program (the school year 1973-1974) and the program used after the end of the demonstration (the autumn semester of the 1975-1976 school year). The cost information about alternative programs will normally involve nothing in the A, B, C, and D1 cost categories which are satellite related. When there was a course before the demonstration, the costs will normally all fall in the D2 category for teachers and other non-satellite related expenses and D3 for learner time in the case of teacher in-service training. In some cases there will be no alternative program offered before the demonstration or after. In some cases after the demonstration ESCD program materials will be used without the satellite delivery system as is contemplated in the Appalachia region.

Partitioning Data Into Meaningful Groups

It will be necessary to group the educational treatments of different sites teaching the same course in order to make meaningful comparisons. For example, in Alaska before the demonstration it is likely that early childhood education was either completely absent or handled through some kind of nursery school arrangement. The nursery school treatments will be documented and averaged and treated as an alternative to the demonstration program. This alternative (let us call it Prior 1-1 as a shorthand for demonstration program number 1, prior alternative number 1) the average costs for Prior 1-1 will be estimated and extrapolated to the seventeen Alaska sites and used as a basis for comparisons with Demo 1 and the other alternatives. In the Rocky Mountains with 56 sites one would anticipate more variations in "prior" practices and in "post" demonstration practices. One would anticipate a clustering into two or three major groups covering 80% to 90% of the sites, with isolated anomalies accounting for the balance. Data will be collected from all sites and costs estimated and extrapolated for the most important clusters. The anomalies will also be analyzed but will be excluded in subsequent analysis unless they seem generalizable and promising for other sites regionally or nationally so they merited additional analysis as "special" alternatives.

In the case of the materials distribution program a simplification will be necessary when materials received by satellite are used in a wide variety of different courses either as enrichment material or as a substitute for teacher time and other material. The evaluators will collect information about the use of material distribution at each site, anticipating a clustering once again, with most of the materials being used in one or two courses and a scattering among other courses. The analysis for comparison with alternatives will be confined to materials used (1) in the career education course that is supported by satellite and (2) one additional course, normally the course that makes the most extensive use of the materials distribution by satellite. Thus, for this satellite application (Demo 13), the cost for the satellite treatment and for each alternative to the satellite (Prior 13-1; Post 13-1) will be a mixture of different courses; however, the comparisons of Demo 13-1, Prior 13-1, and Post 13-1 will be exactly matched courses so comparisons can be made.

Another complication that will be particularly important in Demo 13 is whether the satellite materials are "substituting" for teacher time and other materials or being used as "complements" for "enrichment." Determining how teachers allocate their time is a notoriously difficult area for empirical research based on questionnaires and interviews; based on the experience of Turnkey in past analysis of educational costs PCI will inquire at every site after the demonstration has been completed regarding how the Demo 13 materials were used. If the early analysis reveals that this is a key issue in the cost analysis, a special analysis will be undertaken at a sample of sites to substantiate the treatment of teacher costs. In addition, important findings will be presented with a clear statement about how teacher costs have been allocated and the change in conclusion that would result from construing them in the other fashion.

The economic analysis will use data from outside the ESCD demonstration to force consideration of alternatives that merit consideration for decision about an operational satellite distribution system but were not tested during the demonstration. The alternatives to be explored and the information to be obtained are listed on Page VIII-94 for sensitivity analysis. The procedure for selecting these alternatives was to identify each important component in a model of costs for an operational satellite delivery system and seek out the relevant alternatives to the practices observable during the demonstration. Consequently, if other important alternatives are identified during Phase III, those alternatives will be added to the list for analysis.

Figure VIII-4 summarizes the most important factors for making inferences about an operational satellite system.

There are four kinds of outside information that will be collected:

1. For each important cost component, the relevant alternatives to what was actually done in the demonstration.

2. Audience enhancers -- opportunities to extend the number of viewers for the programs developed in the demonstration and similar materials both to increase the audience benefits and/or to increase revenue to support an operational system.

3. Complementary uses for a satellite transponder to ensure a high percentage of capacity being utilized -- educational applications desired at ESCD sites, FRMS satellite applications like VA hospitals; other education applications like Alaska secondary schools in villages and national programs for handicapped; continued education by MIT, AMA, IEEE and other professional groups; corporations with education programs (e.g., IBM, Postal Service Management Institute); medical applications like APACHE and Vermont-New Hampshire Interact System; computer assisted instruction.

FIGURE VIII-4

INFERENCES ABOUT COSTS FOR AN OPERATIONAL SATELLITE SYSTEM WITH SATELLITE DISTRIBUTION TO (1) ESCD SITES ONLY, (2) MORE SITES IN THE SAME REGION AND (3) NATIONALLY

ESCD Sites-Operational System

The change from demonstration to operational system will change costs as follows:

(1) ESCD Sites Only

Lower annualized costs for long life assets. Longer economic life for satellite, uplink, ground equipment, programming materials, startup costs of regional contractors. Penetration of the potential market will depend on ESCD experience, price, and compatibility with other satellite services.

(2) More Sites in the Same Region

In addition, larger audience reduces cost per viewer hour for fixed cost items like satellite, uplink, and program development. Possible economics in purchasing dishes, VTR's, etc.

(3) National Distribution

In addition, audiences outside the region further reduce the cost per viewer hour for programs that "travel well" (content accepted) and sell well. A more expensive satellite will be necessary. Unit costs for ground equipment may drop further for large orders, e.g., 1,000 or more. Cost estimates will depend on estimates of market penetration at given prices ("demand").

(4) Alternatives to SBES

PCI hypothesizes more variation among alternative approaches than differences within the demonstration. Rather than aggregating across disimilar approaches, PCI will document all approaches actually used at ESCD sites and selectively extrapolate the costs of "real" but "stylized" educational approaches for local, regional, and national audiences, e.g., conventional teacher taught classes, schools with the same programs using VTR.

4. Determinants of the size of the potential market for a satellite-based system including demographic data (population of isolated rural areas; school children; teachers; occupational groups interested in continued education); complementary developments that can extend the market for satellite delivered services; competing systems that are likely to reduce the size of the potential market for a satellite-based services.

The interrogation procedure with reference to these alternatives outside the ESCD demonstration will be to provide the specifications for the thirteen programs demonstrated by ESCD and to document the estimated cost structure and any promising modifications to the system. For alternatives that appear to be superior to the demonstrated approach in ESCD, the costs will be compared to the ESCD technology and extrapolated to an operational system. For example, the cost of ground equipment at receiving sites is a substantial cost element so PCI will contact Hewlett-Packard and competitive vendors regarding the cost of ground equipment, taking advantage of advances in the state of the art if ordered in the same quantity as in ESCD and economies in purchasing if ordered in substantially larger quantities appropriate to a full scale regional system and/or a full scale national distribution system. If there are substantial economies possible, these economies will be taken into account in analysis of the feasibility of an operational satellite system.

This approach is responsive to the concerns of advocates of the satellite system who fear that the satellite system will be judged harshly and unfairly based on technology that was at the state-of-the-art in 1973, is obsolescent in 1974 and will be obsolete in 1976. At the same time, those who are skeptical about the satellite distribution system will be able to discriminate between the "hard data" about observed costs and the "conjectural data" about performance and costs of the most advanced state of the art items.

Attachment B contains the "Input Format" for data collection with a complete set of supporting Schedules A through H.

IV. WORKPLAN FOR ECONOMIC ANALYSIS

The workplan for the cost analysis work is summarized in Figure VIII-5 Noteworthy features of the workplan are the following:

1. Minimizes redundancy -- PCI exploits information generated by NASA and the regional contractors whenever such information is available.

2. Iterative -- Early work with regional contractors and real data about the evolving ESCD programs will lead to refinements in the cost model and focusing of attention on the cost components that appear strategic.

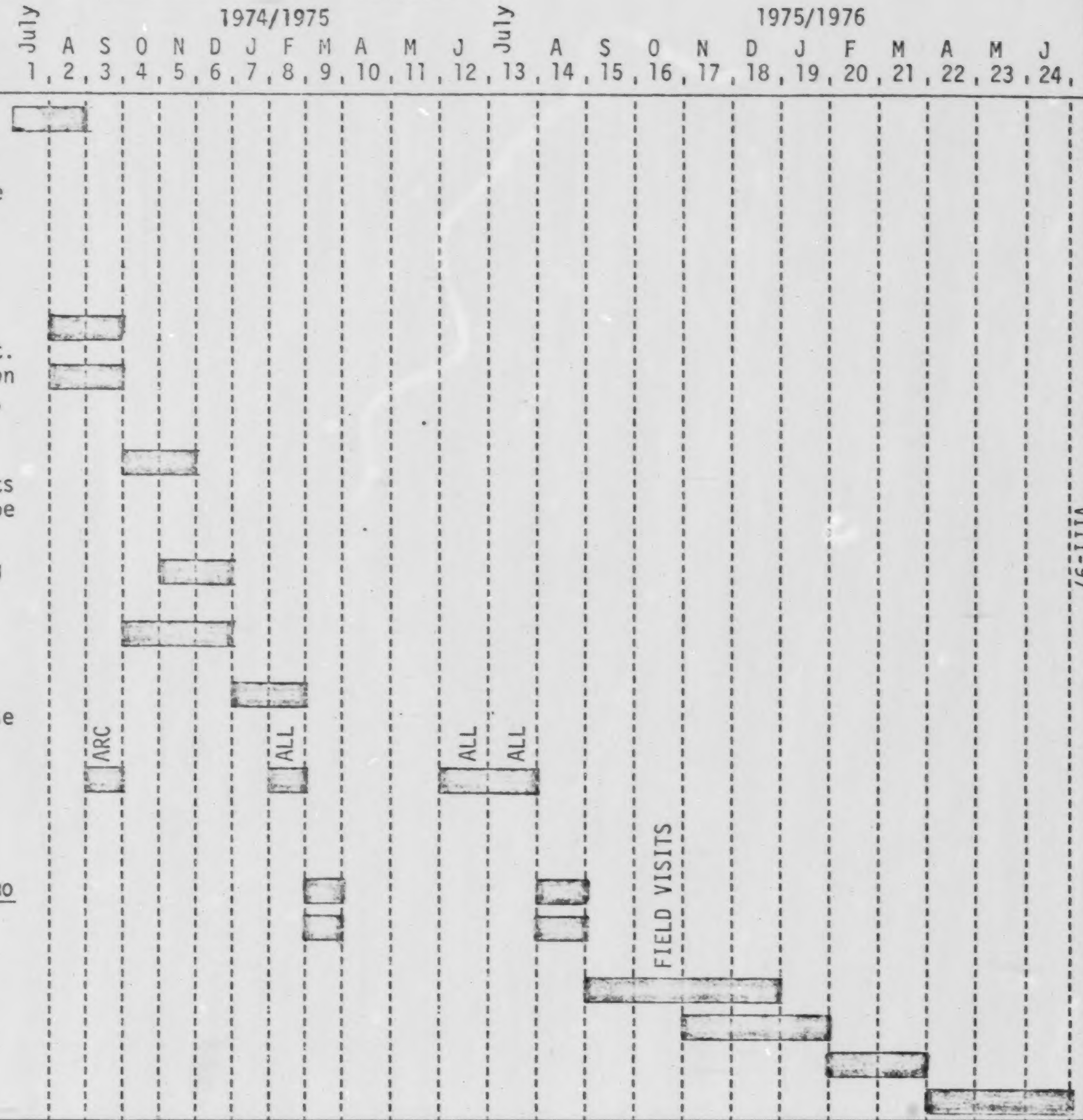
3. Minimal disruption of ESCD -- data collection from satellite users will be delayed to preclude disruption.

FIGURE VIII-5

ECONOMIC ANALYSIS - WORK PLAN

MONTH

MONTHS AFTER START



1. Establish Relationship to Nasa & Regional Contractors: Ensure data available & amenable to proposed analysis. Start collecting data available w/o site visits on 13 programs & prior practices.
2. Test Cost Model manually with Preliminary data for:
   a) All 13 programs-debug; clarify definitions & assumptions, document.
   b) Alternatives for prior year based on information at regional contractor, clarify, debug, document.
3. Establish Relevance of Economic Analysis to Decision Makers: Test results of manual operation; adjust model to be responsive.
4. Develop Computerized Model for storing data, manipulating & extrapolation.
5. Collect Information outside ESCD for alternatives & work through model.
6. Second Iteration of Cost Analysis: prepare; circulate for reaction; revise model for realism & relevance.
7. Data Collection from Sites (site Coordinators when possible) on prior & demo programs & plans for "post", costs, demand.
8. Analysis of Actual Data on Prior & Demo
9. Analysis of Non ESCD Alternatives & Significance for Policy
10. Analysis of Post Programs
11. Integrate with Non-Economic Analysis
12. Reporting
13. Contingencies

ATTACHMENT A

COMPLEXITIES CONSIDERED IN DEVELOPING A COST ANALYSIS MODEL FOR ESCD PROJECT

A cost analysis designed to address the complexities of the ESCD Project is no simple task. First of all the variety of activites taking place within the three regions involved in the demonstration is quite wide including the following thirteen programs:

In Alaska (1) early childhood for 3-5 year olds and their mothers;
(2) oral language development for 5-7 year olds;
(3) health education for 8-10 year olds;
(4) in-service training for teachers and administrators; and

In Appalachia teacher training programs in
(5) elementary reading;
(6) elementary career education;
(7) junior high career education;
(8) senior high career education;

In The Rocky Mountain States
(9) career development for junior high students;
(10) in-service training for teachers;
(11) general interest programs aimed at general audiences; and
(12) a materials distribution program for teaching materials

Beyond this variety of activites is the consideration of the actual implementation and use of each of these progams at the specific individual sites in the three regions including 17 sites in Alaska, 15 in Appalachia, and 56 in the eight Rocky Mountain states participating in the demonstration. Any cost analysis for this project must take the variety of programs and the variations of use of these programs in the 88 individual sites into account in both the model or algorithm used for cost estimation and in the instruments used for gathering data relevant to the analysis.

Additionally, since the demonstration sites for the ESCD Project are school buildings and the bulk of the programs being offered as part of this project may be similar to non-satellite based programs to teach the same material, the model should facilitate comparison between the cost of the satellite-based delivery systems for the demonstration program and alternative non-satellite based delivery systems for these same programs. A series of at least three such alternatives are envisioned.

- The alternative program used by each of the 88 individual sites the year prior to the availability of the satellite. It is possible, and perhaps even expected, that there were some sites with no comparable program;

- The alternative program used by each of the 88 individual sites after June 1975 without availability of the satellite. This particular alternative could vary from the same alternative utilized originally to radical changes caused by the impact of the demonstration; it could happen that a specific program offered during the demonstration year was dropped the following year; and

- Any promising non-satellite based delivery system for the programs determined to be of interest during the demonstration year but not included in either of the two alternatives listed above.

Again, to be of maximum utility to this project the cost analysis must include considerations of the alternatives to the observed satellite-based delivery system for the programs offered during the demonstration year. The cost model and data instruments should be flexible enough to readily allow analysis of any of these non-satellite based alternatives.

A further need to be reflected in the development and application of the cost model for use in this project is the anticipated desire of policy makers at NIE and elsewhere to generalize the cost results of the study for large audiences both within each region and beyond the three regions to a national audience.

That is, given the economics of SBES as observed during the demonstration year, how would these costs and economics be affected by offering a wider audience SBES project? The cost model should allow analysis of the distribution of fixed costs with larger audiences to be performed readily.

THE COST MODEL ITSELF

The cost analysis model to be used should reflect and display the fixed cost nature of certain relevant costs of satellite-based delivery systems for educational programs and the variable cost nature of those remaining cost items for each of thirteen programs to be demonstrated. The basic logical framework for the cost model to be used in this project assumes that each cost factor to be considered will be either fixed or variable with respect to the number of viewers (assumed to vary directly with the number of sites within that particular region) and will also be either fixed or variable with respect to the specific program (of the thirteen listed initially in this section) being offered. Figure VIII-1 displays the four combinations of these factors to be referred to as Group A costs, Group B costs, Group C costs. and Group D costs.

Group A costs are fixed with respect to both the number of sites involved in the demonstration and the specific programs being offered. Included here would be the costs of having the satellite available for use (but not the actual cost of its use) and the cost of any regional user coordination not already specifically allocated to a particular program offering in that region.

Group B costs are fixed with respect to the specific program being offered but variable with respect to the number of sites involved in any particular region. Included here would be the total installation costs for all sites within a region plus any repair and maintenance costs necessary for the upkeep of the site hardware during the demonstration year.

Group C costs vary according to the specific program offering but are fixed with respect to the number of sites involved in any particular region. Included here would be the cost of developing and producing each program offering (or the cost of purchasing or duplicating a previously "canned" program offering) plus the actual broadcast and satellite use costs associated with each program.

Group D costs vary both with respect to the number of sites involved in any particular region (indeed, specifically with respect to the number of viewers or users at each site in the region) and with respect to the specific program offering. Included here would be a series of expenditures (D1) associated with the satellite-based nature of the demonstration project itself such as: operation costs for ground equipment at all sites in the region receiving the program, costs of teacher time and support materials required for classes when the satellite-based program is broadcast to that site, and the costs of user coordination specifically allocated to a particular program offering in that region. Also included here for the purpose of determining the total expenditures of the program offering both in the demonstration year delivery system and in the alternative non-satellite based delivery systems to be considered are a series of expenditures (D2) not associated with the satellite-based nature of the programs offered during the demonstration year such as: costs of teacher time, support materials, and other resource required for the course offering but not related to the satellite-based program (e.g., visit a factory). Learner costs (D3) would also be included in Group D costs but considered separately from school expenditures included in D1 and D2. (Note that all costs in Groups A, B, and C are considered to be expenditures of funds, but only the D1 and D2 portions of Group D costs are expenditures.)

Combining the costs in Groups A, B, C, and D in the appropriate manner will result in an estimate of the total expenditure required for a particular program offering, satellite based or not. For the satellite-based programs during the demonstration year this combination would encompass all of Groups A, B, and C plus the D1 and D2 portions of Group D cost. For the non-satellite based alternative programs, this combination would exclude all of Groups A, B, and C and D1 leaving only D2 portion of the Group D costs.

Variables can be combined to calculate three kinds of summary statistics on costs:

- Total SBES related costs per year and eventually the cost per viewer hour when the total viewer hours for each of these programs is obtained.

- Total expenditures per course or per year -- total SBES related costs plus non-SBES related expenditures and eventually the cost per learner hour when the total learner hours for each of these programs is obtained; this statistic would be especially useful in comparisons of satellite-based delivery systems versus traditional methods of supplying the same instructional service.

- Total costs associated with the program -- including the above total expenditures per year plus the value of learner time (D3) when appropriate; this parameter would not be different for grammar school or pre-school students, whose time has no significant economic value. It is likely to be very important for adult programs or teacher inservice training that involves time away from work.

SUMMARY OF COST DATA FOR 13 DEMONSTRATION PROGRAMS AND COMPARISON GROUPS

	13 APPLICATIONS TESTED IN DEMO (A) (1974-1975)															
	ALASKA					APPALACHIA				ROCKIES						
TYPE OF COST - FIXED OR VARIABLE WITH RESPECT TO SPECIFIC PROGRAM/# SITES	1. Early Childhood	2. Oral Language	3. Health Education	4. Teacher In-Service	5. Viewer Defined (Native Magazine)	6. Teachers-Elementary Reading	7. Teachers-Elementary Career Ed.	8. Teachers-Jr. High Career Ed.	9. Teachers-Jr. High Career Ed.	10. Jr. High-Career Ed.	11. Teachers-Career Ed.	12. General Audience	13. Materials Distribution	0-26 COMPARISON GROUPS - "PRIOR" TO DEMO (1973 - 1974)	0-26 COMPARISON GROUPS - BEST ALTERNATIVE "POST" DEMO (ACTUAL OBSERVATION 1975-76	13-26 SPECIAL ALTERNATIVES - OUTSIDE DEMO SITES ALTERNATIVES TO ESCD PRACTICES
A. FIXED/FIXED (w.r.t. # sites/program)																
1. Broadcast-Transmit Capability:																
a. Satellite & Broadcasting - non-recurring costs not specifically allocated (annualized) (Schedule E)																
b. Allocation to application i (% annual broadcast hours on satellite ed transponder) (A & E).																
2. Regional User Coordination																
a. All costs not allocated to specific applications (F).																
b. Allocation to application i (% of total program hours transmitted) (A & E).																
B. FIXED/VAR - Costs independent w.r.t.# Sites, Type of Site																
1. Site Installation Cost (annualized) (sum of all sites in region) (C).																
a. Allocation to application i (% of annual terminal use x B1) (A & C).																
2. Site repairs and maintenance (annual) (C).																
a. Allocation to application i (% of annual hours terminal use x B2) (A & C).																
C. VAR/FIXED - Costs Vary by Program not by Number of Sites																
1. Non-recurring Development and Production of Materials (annualized) (B) (Deduct revenue from sale for other users) (H)																
2. Satellite and Broadcast Cost (annual hours use x $/hrs not incorporated in A1) (ATS-F, ATS-1, and ATS-3) Recurring Costs. (E)																
D. VAR/VAR - Costs vary by program and also by number of sites.																
1. Satellite Based Educational Services (SBES) related expenditures																
a. Site equipment operation ($/hrs not included in B2 x hrs per year) (D).																
b. Classroom costs: SBES related																
i. Teacher time (average annual salary x fringe benefit multiplier x hrs for SBES course ÷ total work hr/yr) (D).																
ii. Materials & other related support for instruction ($/yr in course using SBES) (D).																
c. User Coordination -- specific to application (F).																
2. Expenditures not related to SBES																
a. Teacher time (same course as SBES but excluded from D.1.b)																
b. Other costs (same course as SBES but excluded from D.1.c.)																
3. Learner Costs																
a. Time away from work (annual salary ÷ % of work yr. lost for course) (G).																
E. Audience and Summary Statistics																
1. Average Audience																
2. Total SBES hours received/yr.																
3. SBES related cost per viewer hour (A + B + C + D1 + E1 + E2)																
4. Expenditures per learner (A + B + C + D1 + D2 + D3 + E1)																

TABLE II - DETAILED SCHEDULES OF COSTS FOR EACH COMPONENT IN TABLE I FOR 13 APPLICATIONS

SCHEDULE A: DESCRIPTION OF ESCD PROGRAM APPLICATIONS

Region & Type of Application	No. of Segments	Length in Time	Total No. of Hours	Broadcasts				Audience		
				Times	Season	Format	Type	No. of Partici-pants	No. of Sites	No./Site
ALASKA										
Early Childhood										
Oral Language Development										
Health Education										
Teacher In-Service										
Viewer Defined										
APPALACHIA										
Teachers - Elementary Reading										
Teachers - Elementary Career Ed.										
Teachers - Jr. High Career Education										
Teachers - Sr. High Career Education										
ROCKY MOUNTAIN										
Jr. High Career Development										
Teachers In-Service										
General Audience Materials Distribution										

TABLE II: SCHEDULE B -- DEVELOPMENT AND PRODUCTION EXPENDITURES

V

Region & Type of Application	Pre-Production Research	Script & Creation	Studio & Materials	Promotion	Utilization & Evaluation	Total Expenditures	Per Hour Expend.
ALASKA							
Early Childhood							
Oral Language Development							
Health Education							
Teacher In-Service							
Viewer Defined							
APPALACHIA							
Teachers - Elementary Reading							
Teachers - Elementary Career Education							
Teachers - Jr. High Career Education							
Teachers - Sr. High Career Education							
ROCKY MOUNTAIN							
Jr. High Career Development							
Teachers In-Service							
General Audience							
Materials Distribution							

TABLE II: SCHEDULE C: ANALYSIS OF SITE EXPENDITURES*

Regions	No. of Sites	INITIAL EXPENDITURES						OPERATING (VARIABLE) EXPENDITURES			YEARLY COSTS/SITE			No. of Hours Terminal Used Yearly	Average Yearly Costs Per Hour Terminal Use
		Basic	Years Life	Options	Years Life	Total	Annualized Total	Maintenance	Other	Total	Initial	Variable	Total		
ALASKA															
ITV															
ROT															
Open															
Sub-Total:															
APPALACHIA															
ITV															
ROT															
Open															
Sub-Total:															
ROCKY MOUNTAIN															
ITV															
ROT															
Open															
Sub-Total:															

---

* Except those related to specific applications

SCHEDULE D: TEACHER COSTS, SUPPORT MATERIALS, AND OTHER COSTS AT SITES

VII

	TEACHER COSTS						D.1.b.ii. SBES Related Support Materials & Other Costs (7)	D.2.b. Non-SBES & Other Costs
	Adjusted* Yearly Salary (1)	No. of** ESCD Hours/Yr (2)	Other *** Teacher Hours/Yr Same Course (3)	Total Hr/Yr Same Teacher For All Courses (4)	D.1.b.i. SBES Related Teacher Costs (1x2:4)(5)	D.2.a. Non-SBES Related Teacher Cost (1 x 3 : 4) (6)		
ALASKA								
Early Childhood								
Oral Language Development								
Health Education								
Teacher In-Service								
Viewer Defined								
APPALACHIA								
Elementary Reading								
Elementary Career Education								
Jr. High Career Education								
Sr. High Career Education								
ROCKY MOUNTAIN								
Career Development								
Teacher In-Service								
General Audience								
Materials Distribution								

* Adjusted for fringe benefits and weighted according to "teachers" per site.
** All hours for the course on days with satellite broadcasts.
*** All hours for the course not included in column 2.

SCHEDULE E: SATELLITE COSTS/YEAR FOR ESCD APPLICATIONS

Type of Satellite	Satellite Channel			Tracking & Telemetry		
	Fixed Expd. Per Channel	Expected Yrs Life	# of ESCD Channels Times Yearly Exp. per Channel	T&T Exp. Per Year	% T&T Requested by ESCD	T&T Cost for ESCD
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATS-F						
ATS-1						
ATS-3						
RCA-4						
Hughes?						

VIII

Type of Satellite	Up-Link Expenditures					Yearly Total Satellite Expend.	Yearly Total Hours Bdcast	Average Yearly Expnd. Per Hour
	Net Capital Expenditures	Installation Expenditures	Expected Life	Annualized Capital Exp.	Maintenance Expend./Year			
(1)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
ATS-F								
ATS-1								
ATS-3								
RCA-4								
Hughes?								

SCHEDULE F: USER ORGANIZATION COSTS -- NOT ELSEWHERE COUNTED*

	ADMINISTRATION** (1)	BROADCAST & ENGINEERING (2)	EQUIPMENT/ FACILITIES (3)	PROGRAM (4)	RESEARCH (5)	UTILIZATION (6)
COSTS SPECIFIC TO A SPECIFIC APPLICATION n.e.c. (D.1.c.)						
ALASKA						
DEMO 1						
DEMO 2						
DEMO 3						
DEMO 4						
DEMO 5						
APPALACHIA						
DEMO 6						
DEMO 7						
DEMO 8						
DEMO 9						
ROCKY MOUNTAINS						
DEMO 10						
DEMO 11						
DEMO 12						
DEMO 13						
COSTS NOT ALLOCATED TO A SPECIFIC APPLICATION n.e.c. (A.2)						
Alaska						
ARC						
FRMS						

---

* Includes subcontracts, not elsewhere counted

** Includes data processing, DUT personnel

SCHEDULE G: VALUE OF LEARNER TIME

	# LEARNERS QUALIFIED* (#) (1)	AVERAGE TIME IN CLASS (HRS) (2)	AVERAGE TRAVEL TIME (HRS) (3)	AVERAGE ESTIMATED ED. TIME OUT OF CLASS (HRS) (4)	TOTAL TIME FOR COURSE (HRS) (5)	% OF WORK YEAR ** (%) (6)	AVERAGE SALARY/ $ YR*** ($) (7)	OTHER† EXPENSES TO LEARNERS (+) (8)	VALUE OF LEARNER TIME $ (6+7)+8 (9)
TEACHERS IN-SERVICE TRAINING									
Demo 4 - Alaska									
Demo 6 - ARC Elementary Reading									
Demo 7 - ARC Elem. Career Ed.									
Demo 8 - ARC Jr. High Career Ed.									
Demo 9 - ARC Sr. High Career Ed.									
Demo 11 - Rockies									
GENERAL AUDIENCE									
Demo 5 - Alaska Native Magazine									
Demo 12 - Rockies General Audience									

* Learners away from work to attend course; the implication is that time saved by increased convenience could be used for other work. Any time that could not be recaptured by the employer will not be counted. Assumptions will be made explicit and consistent between satellite & non-satellite courses.

** Make explicit # hours per work year & be consistent between all courses.

*** Cost to employer including fringe benefits.

† Transportation, books, etc.

SCHEDULE H: REVENUE FROM SALE OF BYPRODUCTS FROM ESCD PROGRAMMING

PROGRAM	ACTUAL REVENUE	COMMENTS: Product Sold; Potential for Further Sales; Free Distribution; Purchasers; Plans for Exploitation for Revenue.
ALASKA		
Demo 1		
Demo 2		
Demo 3		
Demo 4		
Demo 5		
APPALACHIA		
Demo 6		
Demo 7		
Demo 8		
Demo 9		
ROCKY MOUNTAINS		
Demo 10		
Demo 11		
Demo 12		
Demo 13		

SECTION IX

ECONOMIC/ENGINEERING ANALYSIS

In this section we present *in toto* the document prepared by PCI's subcontractor, Econ, Incorporated. Econ is a Princeton based firm that specializes in economic and engineering analysis of satellite technology. We present their report in its entirety because it fully responds to the technology-oriented analyses required under our contract.

It is PCI's intention to honor the spirit of this Econ report by in fact accomplishing the engineering, economic analyses, and various trade-offs studies set forth in this document. However, based on our strategy of non-intervention in the experimental site, rather than going forward with an on-site engineering analysis, we will rely upon the regional evaluation capability, and PCI participation in regional evaluation teams to generate the engineering and cost data required for this study. Hence, as noted in our management plan, we will be procuring from Econ not the full range of services as described here but rather the services of the three key individuals -- Messrs. Miller, Hicks, and Greenberg, and on a consulting basis their senior staff such as Messrs. Masch and Heiss.

We repeat, we will comply with the intent of the work set forth in the following but are not limited to these specific means of implementation.

TECHNICAL AND ECONOMIC EVALUATIONS OF THE ATS-F ETV EXPERIMENT

A Proposal Submitted to

Practical Concepts, Inc.
1030 15th Street, Suite 940
Washington, D.C. 20005

by

ECON, Inc.
Princeton, N. J.

May 14, 1974

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1. INTRODUCTION

The national concern with equal educational opportunity and the need to develop an educational process that will assure a full and appropriate development of the nation's talent, has motivated the search for contributing roles for technological systems within the educational structures.

Instructional/Educational broadcasting has been well studied producing, for example, the 500 radio stations of the National Education Networks, the six regional ETU networks with approximately 219 stations and the Instructional Television Fixed Service microwave network with approximately 160 transmitters and more than 560 TV channels.

Proponents of educational technology systems, in attempting to define the application of technology in the classroom have recommended a variety of combinations. These range from voice combined with written work programs to duplex TV with multiple access. However, no single or optimum application method has emerged.

Current applications of technology to education tend to concentrate on services to densely populated national regions and the large fraction of the 113,000 educational institutions located there. However, approximately 25% of these educational institutions serve the nation's remote regions and a major problem is to assure that these particular students are kept in the mainstream of educational progress.

Throughout all investigations and developments of educational technology systems runs the thread of a need for economic effiiciency in system purchase and operating costs. Since there has been little clarification of the amount of money an educational jurisdiction would allocate to a system design, the trend has been to seek minimum cost technology solutions. This approach does not generally result in a system beneficial to education.

The ATS-F educational TV experiments and the associated narrow band communication channels will attempt to demonstrate the capability of technology to respond to remote area educational needs and to produce this response at reasonable user costs. A successful demonstration of a technical capacity to deliver programming materials, using sophisticated technology sub systems, will eliminate uncertainty associated with delivery, and allow educators to concentrate on the process of education using the delivery technology.

The ATS-F experimental results properly evaluated, therefore, in terms of technical, economic and educational performance can be used to develop a basis of observational knowledge. This basis can be employed to define educational delivery structures necessary to the nation's needs and can permit the technology of satellite delivery to be compared with alternative systems technologies.

The content of this proposal is directed to the process of evaluation of two of the three performance measures; the technical and economic performance evaluations and with the extension and expansion of the resulting experimental basis to operational educational systems.

2. COMMUNICATION SYSTEM TECHNICAL DISCUSSION

2.1 Communication System Design and Operating Characteristics Introduction

The Communication System is the mechanism by which and through which potential educational objectives in the classrooms will be realized. It includes, therefore, all the operating equipments required to deliver the educational programs to the classroom receiver/monitors; the equipments required for interactive responses to the educational programs and the equipment required for data and administrative traffic amongst the structure of terminals.

The terminals of the system are not all alike. They are characterized as receive, intensive, and comprehensive. The receive terminal can only receive TV signal input; the intensive terminal can receive a TV signal input and can also transmit and receive a voice signal; the comprehensive terminal can receive and transmit a TV signal and also transmit and receive a voice signal.

The classroom receiver/monitor receives a synchronized aural visual signal. Visual quality for a color display in a viewing area is defined in terms of the following parameters:

1. Picture resolution
2. Picture chromaticity
3. Signal linearity and synchronization
4. Picture brightness
5. Background illumination

Of these parameters, 1, 2, and 3 are dependent on the content and quality of the received signal and 4 and 5 are controllable within the classroom. Only 1, 2, and 3 will be discussed in this technical discussion.

A voice signal accompanying a video signal is generally accepted to be less subject to degradations that the video signal itself, so that the technical discussion will concentrate on the video signal possible variations. Voice and data signals employed for interactive purposes will be discussed separately.

Two communication systems will be discussed. The first system is that currently designed and designated as ATS-F. The second system will be called an operational system which means that it is a system designed for educational networking in the future. Since the exact form of this operational system cannot be stated with a high degree of confidence, the discussion will concentrate on the differences in design and operating characteristics that might be expected in an operational system.

The communication system operating characteristics define some of the parameters of significance to the educational impact of the designed educational program on the pupil/teacher audience. Variations in the system operating characteristics can be expected to produce variations in this educational impact.

Thus the technical discussion will be oriented to the system delivery design objectives and to deviations from these objectives that may occur during the experimental period from a variety of technical causes.

2.2 The Experimental Education System of ATS-F

ATS-F will conduct multiple experimental missions from space. One of these experiments is the Educational Television experiment (ETV). The ATS-F will be the first NASA spacecraft to be three-axis stabilized in synchronous orbit. It will be used to demonstrate that a 30-foot parabolic antenna can be deployed in space. It will be used to demonstrate a design capability for fine pointing accuracy, 0.1°, a design capability for precision slewing of an antenna beam at 17.5° in 30 minutes and a capability for precision tracking of a ground point since the orbital inclination of ATS-F will be 1.8° and not 0°. All of these cited experimental objectives may influence the ETV signal reception.

The ETV earth receiving antenna with its 7.2 db/$^{\circ}$K figure of merit is a newly designed, 3-meter diameter, four petalled fiberglass plastic structure mounted on a pedestal. It is an experimental design with its operating feasibility established in a measurements program. The earth receiving equipment preamplifier and receiver have been very simply designed to receive two color TV channels at minimum cost. Because of the simple design, cable lengths from antenna to receiver and from receiver to TV display must be controlled to 100' and 300' respectively if no signal loss is to occur. Each earth receiver is equipped with a signal meter which can be visually observed and used to orient the earth receiver antenna to maximize the received signal. In addition, provision is made on board the spacecraft for reorientation of the spacecraft antenna boresight or pointing to move the antenna fields of view to improve performance.

The operating carrier frequencies for each TV channel are at 2.5692 GHz and 2.670 GHz selected by NASA to simplify communication system design. These frequencies are in the newly allocated 2.5 GHz band only recently approved for satellite down links. As a consequence the precise nature of the atmospheric interaction with these carrier frequencies is not known although it is estimated to be extremely small. Each earth receiver can be switched between TV channels, manually.

The ETV system radio frequency modulation for the two TV channels, two aural channels, four sound channels and telephony channels is frequency modulation (FM). Since the normal TV receiver is designed for reception of Amplitude Modulation (AM) video signals, each receiving system must employ a conversion from FM to AM.

The ETV downlink signal is left circularly polarized and the atmosphere could modify this polarization and produce losses at the receiving antenna.

Each of these general system characteristics could result in signal reception deviations from the nominal design or could produce geographic and/or time signal variations, at the system receiving terminal.

ETV Specific Systems Structures: Each regional educational experiment is specifically structured. These structural forms are shown in Figures 2.1, 2.2, and 2.3 for the Appalachian Regional Commission (ARC), the Federation of Rocky Mountain States (FRMS) and Alaska respectively.

The ARC experiment has different origins for pretaped audio and live video and aural programming but it is not expected that any signal variations should result from this. The satellite downlink employs two fixed beams (north and south) and transmits programming directly to 10 receive and 5 intensive terminals. The intensive terminals can employ a full duplex VHF audio and data link via ATS-3 among them and with the University of Kentucky where the experimentor is located.

The FRMS experiment has a single programming source but must use two individual pointings of a pair of beams to produce the required coverage. This experiment transmits programming to 44 receive only terminals and 24 intensive terminals. Audio and data can be sent via ATS-3 from and among the 24 intensive terminals in a half duplex mode so that data and call/admin communications are entirely separated.

FIGURE 2.1 ATS-F EDUCATIONAL TV EXPERIMENT-ARC SYSTEM STRUCTURE
Educational Programs: Early Elementary Grade Reading
Career Education Elementary and Secondary

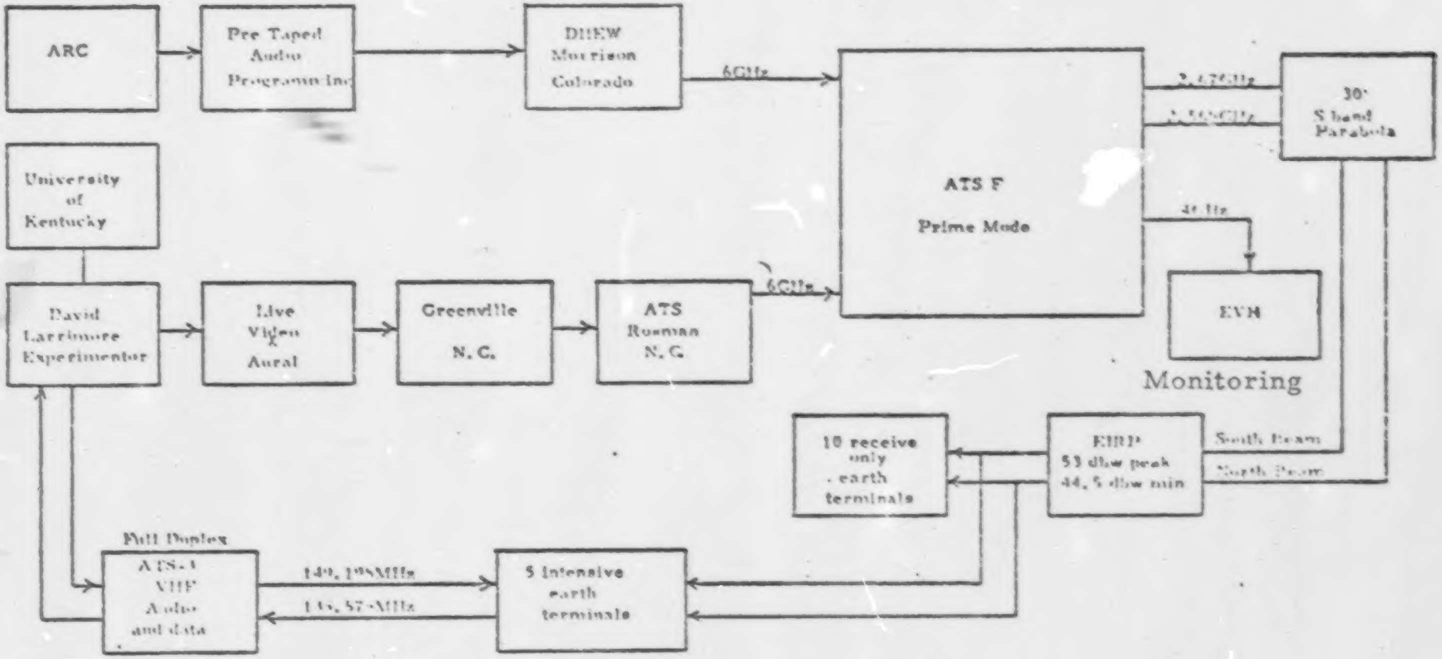

ARC
Pre Taped Audio Programming
DHEW Morrison Colorado
6GHz
ATS F Prime Mode
2.478GHz
2.569GHz
30' S band Parabola
University of Kentucky
David Larrimore Experimentor
Live Video & Aural
Greenville N. C.
ATS Rosman N. C.
6GHz
EVH
Monitoring
10 receive only earth terminals
EIRP 53 dbw peak 44.5 dbw min
South Beam
North Beam
Full Duplex
ATS-1 VHF Audio and data
149.198MHz
135.57 MHz
5 intensive earth terminals

FIGURE 2.2 ATS-F EDUCATIONAL TV EXPERIMENT - FRMS SYSTEM STRUCTURE
Educational Programs: Career education for rural isolated junior high school students

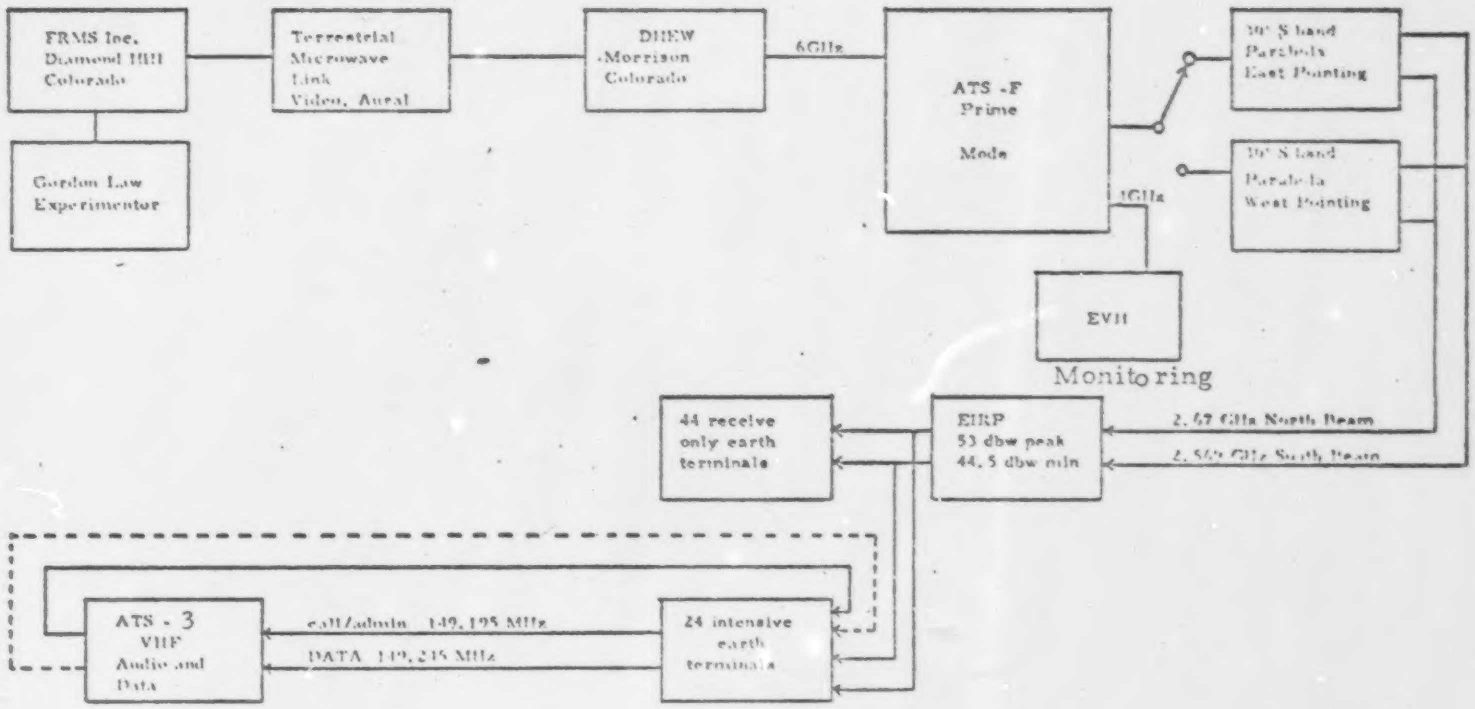
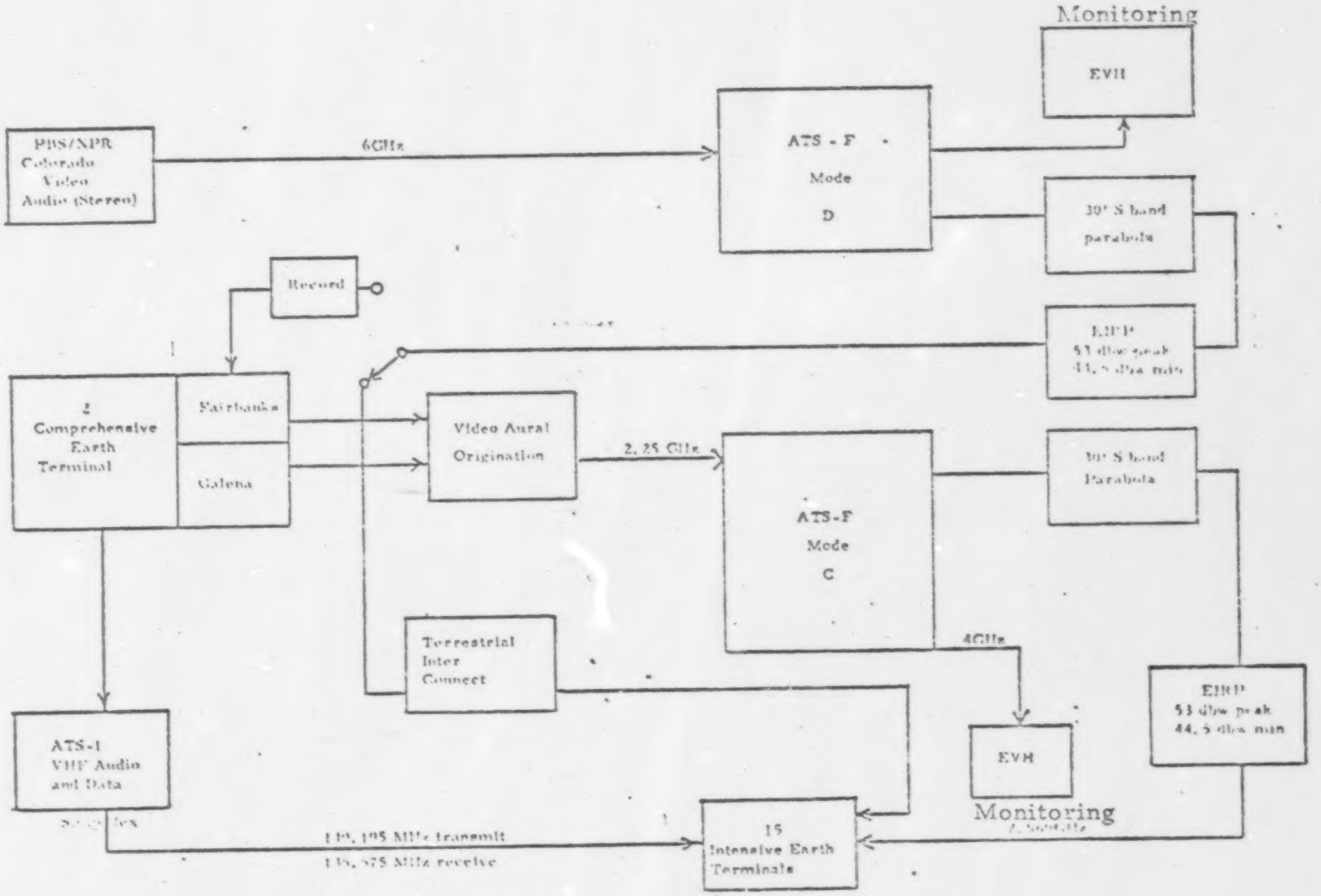

FRMS Inc.
Diamond Hill
Colorado
Gordon Law
Experimentor
Terrestrial
Microwave
Link
Video, Aural
DHEW
Morrison
Colorado
6GHz
ATS -F
Prime
Mode
4GHz
EVH
Monitoring
30' S band
Parabola
East Pointing
30' S band
Parabola
West Pointing
2.67 GHz North Beam
2.569 GHz South Beam
EIRP
53 dbw peak
44.5 dbw min
44 receive
only earth
terminals
24 intensive
earth
terminals
call/admin 149.195 MHz
DATA 149.215 MHz
ATS - 3
VHF
Audio and
Data

FIGURE 2.3 ATS-F EDUCATIONAL TV EXPERIMENT - ALASKA SYSTEM STRUCTURE
Educational Programs: Early Childhood Basic English Communication (4-7 years)
pre taped video for Alaskan Native Population


Monitoring
EVH
PBS/NPR
Colorado
Video
Audio (Stereo)
6GHz
ATS - F
Mode
D
30' S band
parabola
Record
EIRP
53 dbw peak
44.5 dbw min
2
Comprehensive
Earth
Terminal
Fairbanks
Galena
Video Aural
Origination
2.25 GHz
30' S band
Parabola
ATS-F
Mode
C
Terrestrial
Inter
Connect
4GHz
EVH
EIRP
53 dbw peak
44.5 dbw min
ATS-1
VHF Audio
and Data
Simplex
149, 195 MHz transmit
135, 575 MHz receive
15
Intensive Earth
Terminals
Monitoring

The Alaska experiment permits programming origination at two comprehensive terminals in Alaska at Fairbanks and Galena or alternatively in Colorado. From Colorado via ATS-F the programming can be either recorded at Fairbanks or sent directly by an undefined terrestrial interconnect to 15 intensive earth terminals. The 15 intensive earth terminals have a simplex link via ATS-1 at VHF for audio and data to the comprehensive earth terminals. The undefined terrestrial interconnect may imply unknown signalsmodification for certain programming inputs. Each application transmit the downgoing programming simultaneously over an Earth Viewing Horn (EVH) for monitoring of the program material.

The Nominal System Design Parameters: The system spacecraft gain, rf power, the earth terminal antenna, preamplifier and receiver have been selected and designed to provide a TASO grade 1 signal at the TV receiver. This requires a signal-to-noise ratio, S/N, of 43 db, and provides the best subjective TV picture for all but 1% of the population under normal viewing conditions. Again as a design goal it is not expected that the value of S/N will be less than that of TASO 2 for a fine picture at any receiving site.

Voice quality throughout is defined by an S/N of 42 or 43 dbs, a subjective grade between good and excellent.

The geographic coverage of the antennas, as achieved by beamwidth, stabilization, pointing and tracking will be supplied with signal quality appropriate to these subjective quality definitions.

Local Influences on Signal Quality: The nominal system design signal parameters provide the picture and sound quality specified if the noise in the system is only that collected by the receiving antenna at each site and if the receiving set is properly adjusted and installation is according to specifications.

Other forms of "noise" or interference can be generated locally to produce picture and sound degradation which must be handled as a local adjustment problem for each site where it occurs. These local forms of noise are described as "ghosts" or "snow" often correctible by antenna adjustment, or radio frequency interference (RFI) resulting from locally generated rf signals in the system operating bandwidths.

In addition, since the system carrier frequencies lie in the bandwidth of the ground operating instructional television fixed service (ITFS) operating frequencies, any ITFS transmitter may interfere with reception unless the separation or coordination distances have been properly specified.

The standardized classroom receiver is an RCA LYCEUM 25" all solid-state device XL100 especially designed as an Instructional Receiver/Monitor designated JT 970-W. The set is factory-aligned to specifications incorporating both technical and viewer subjective factors. Subsequent to installation the set is automatically controlled for performance although the automatic feature can be overridden and manually adjusted according to viewer preferences.

Programming Hours Expected for the System: The programming hours are tentatively as follows:

- July - mid-August 1974
  - 4 hours/week pretaped new TV production
  - 1 hour/week audio based programmed instruction
- September 1974 - May 1975
  - 2 hours/week live video with interactive audio.
- A minimum of 2 hours/week of computer-managed instruction
- 6-week seminar from the University of Kentucky to ARC beginning 2 July 1974.

This technical review of the Educational Experiment of ATS-F has indicated that there are potentially many sources of possible degradation of the signal-to-noise ratio which identifies the technical/subjective quality of the program presentation in the classroom.

Subsequently measurement techniques will be discussed that will be employed to monitor the technical/subjective system operating quality.

It is expected that monitoring will be necessary outside the programming hours and during the programming hours.

2.3 The Educational Operational System

The general consensus of the experts in satellite educational programming networking, such as Morgan and Singh at Washington University, St. Louis, is that the primary constraint on the development of an educational operating system will be economic and jurisdictional rather than technical. Nevertheless, many system technical choices and decisions will have to be made in designing an operational system, some of which will be made for economic reasons. Unless, however, the end technology, i.e., that used in the classroom is changed from its current operating characteristics, the precise technical methods for delivering the programming material must be compatible with the end technology. This will always require signal conversions to be made appropriately, between the earth receiving antennas and the classroom equipment, as with ATS-F. It is possible that if the cost of transmission is appreciably reduced, then reduced costs in end technology may be sought and totally new concepts of educational programming presentation may emerge. At this time, no essentially new presentation concepts are under development but rather, investigations are being made to define and select combinations of current presentation techniques for "optimum" educational presentation. Thus, for the evaluation of in-classroom educational effectiveness, technical measurements in support of effectiveness quantification will remain essentially unchanged in fundamentals from those developed for ATS-F.

End technology development is moving to solid state wall panel displays with higher resolution potential than currently exists in the every day TV set. It is possible that an operational educational TV system, if it offers a large market for a manufacturer, could result in a TV display specialized for education and classroom presentation. This would require technical educational parameters to be developed, in particular, spatial resolution and color resolution, and brightness appropriate to the education environment.

In many educational applications single frame presentations of various types have been seen as advantageous. Storage media are available for such approaches and are under development for some of the systems being conceived for cable TV.

For an operational system, it appears reasonable to assume that the system design will embody signal processing and signal transmission for real time continuous or consolidated evaluations of the classroom educational interaction, and that evaluation would be centralized at some level, via the satellites in the system. This will require the development of appropriate evaluation observables, by the educators, and the design of an appropriate accessing procedure for the transmissions.

The following technical discussion will be directed to the technical changes that could be incorporated into an operational system design.

Operational System Technical Discussion: Any future operational system must be designed in such a way as to minimize its interference with other systems operating terrestrially and in space in the same frequency band. This requirement and the need for increasing numbers of TV channels to be available will urge educational networks to an operating carrier frequency of 12 GHz. Since this frequency is completely unregulated, the downlink power can be the maximum attainable from the technology. Development is currently under way in the U.S., Japan and Germany to produce the required 12 GHz technology with some development being devoted to create "cheap and dirty" multi-TV channel receivers and converters for the earth terminals. Concurrent with the trend to 12 GHz employment are investigations to increase and define the localized influences of precipitation (rain, snow, ice) on the received signal amplitude, phase and polarization, to clarify the expected atmospheric influence. The current data is very limited, and perhaps limits the transition to 12 GHz carriers.

TV signals are currently accepted as analog inputs to the process of signal modulation, which is usually FM. Current and future trends are to digitalization of both TV and voice basebands (basic information), to more effectively use the powers and bandwidths available and to reduce transmission errors in the baseband information. If digitalized processing is employed along with multiple accessing of the system, then the most efficient modulation method still remains controversial, as does the best signal modulation for a minimum cost earth station. Digitalized processing and the availability of high speed digital circuitry makes it practical to implement TV signal bandwidth compression or reduction techniques by specializations in signal sampling, combined with some signal storage equipment.

At 2.5 GHz, a single antenna beam can carry approximately 4 or 5 TV channels. At 12 GHz the bandwidth in the beam can accommodate about 12 TV channels. With digitalization and the same delivery quality, the number of TV channels could be doubled. Expansion of the number of TV channels can be further achieved by employing dual polarization in the signal which are mutually orthogonal. If dual polarization is needed to achieve the number of TV channels required per receiving site, then the transmission antennas and the earth receiving antennas must effectively isolate the individual polarizations. Atmospheric polarization variations can limit the actual achievable isolation between polarizations. When the problem of antenna alignment is considered, it is not clear whether linear or circular polarization should be chosen for the system operation. The significance of being able to clearly define the number of TV channels required per receiving site in the system is apparent. Efficient use of available space power, again directed to reduced cost of earth terminals, can result from the development of multiple antenna beams, formed from a single antenna structure in space. If the beams can be also readily conformed to variations in coverage area required, this will result in power being put only where it is needed and the use of the power will be maximized.

The technical advances discussed in this section are some steps in sophistication beyond ATS-F and are likely to be fully developed only if there is a clear need.

2.4 Technical Performance Measurements

To support the evaluation of the educational process in the classroom, it is necessary to establish certain objective technical measurements that determine the technical quality of the delivery of the broadband TV programming material and the available interactive voice/data/administrative narrow band channels. The purpose of these technical measurements is to establish the acceptability of other measurements of the educational quality or utility of the experiment for composing valid statistical descriptions of the results of the educational interaction. A decline in apparent educational utility can then be cross correlated with an inadequacy in technical delivery of the required signals.

Since the end technology in the classroom, with the correct signal inputs, will not perform correctly unless it is operating properly and is properly maintained, it is necessary to identify the operating and maintenance status of the end technology equipment. A decline in apparent educational utility can then be cross correlated with improperly operating equipment and the cause of improper operation.

In concept, the experimental design of the receiving sites equipment, is thought of as being low maintenance. The maintenance statistics can then confirm this concept if criteria for low maintenance have been established.

As stated in the General Section of the Experimental Education System of ATS-F (2-2) many experimental ATS-F subsystems can produce technical performance deviations in delivery. Since it is the responsibility of NASA to ascertain and maintain design performance of these experimental systems it is assumed that NASA telemetry records will be available for cross correlation between experimental spacecraft system performance and the measured educational utility. Similarly it is the responsibility of NASA to maintain appropriate operating performance and circuit availability on board ATS-1 and ATS-3 during the ETV experiment and it is assumed that NASA telemetry records will be available to cross correlate with educational utility for interactive voice computer managed instruction, data and administrative links.

It is presumed, since each TV transmission via ATS-F at 2.5 GHz is also transmitted at 4 GHz on the Earth Viewing Horn (EVH), that program originators will monitor via the EVH, to produce a picture appropriate to their programming desires, and to maintain appropriate visual - aural quality in the transmission.

The quantitative measures of educational quality or utility are not of concern in this direction. It is assumed that they will be discussed elsewhere. The only assumption made concerning educational quality measures is that they will be uniform for each functional task at each site. The definition of functional task may or may not include the population to be served.

The Technical Performance Measurements (TPM) program to be discussed subsequently will essentially validate educational utility quantitatives at each site in an educational experiment. Or alternatively the TPM may be employed to weight appropriately the educational utility quantitatives.

The TPM structure will be similar to that adopted in any observational measurements experiments. Instrumentation equipment is installed and checked out according to specifications. The instrumentation is calibrated by observing its response to standardized inputs, possibly before the experiment and after the experiment. Calibration differences between before and after the experiment may occur within some bounds, defined by the experimental observables, as being insignificant to the experimental results. Calibration quantitatives can be expected to be determined precisely. During the course of the experiment, extraneous influences may introduce inimical effects or the calibrated instrumentation may break down or fail catastrophically, etc. Qualitative recording of in-progress, unexpected variations in instrumentation performance is desirable.

2.5 The Technical Performance Measurements Program

This program consists of a sequence of dependent steps in procedures, inspections, installation, static testing and dynamic testing.

Each receiving site will be prepared to an operational status verifying the availability and operability of the on-site equipment. Intermittently according to programming schedules the site will be advanced to a readiness status which identifies its satisfactory condition for program receipt and interactive operation, where appropriate.

1. Establishment of Site Operational Status

(a) Visual inspection of all equipment inside and outside.

(b) Installation team installs antenna, receiving equipment and cabling according to site specifications.

(c) Operating team installs TV receiver and interactive microphones according to specifications and to classroom size and expected audience.

(d) Installation and operating team verify coupling from external equipment to internal equipment i.e. continuity, the power on condition and static testing losses by using test signals.

(e) TV set manual operating control verification and microphone operating control verification is performed by the operating team.

(f) Operating team verifies classroom lighting operation and control and class seating arrangement so that each student and teaching staff can have an unobstructed view of screen. Operating team, where appropriate verifies the availability of the interactive microphone to all of the audience.

Satisfactory completion of these six steps establishes the operational status of the site. If the steps cannot be satisfactorily completed, then a failure report must be prepared and the reasons for failure established. Repair or replacement will then be required for achievement of operational status.

(g) The cause of failure to achieve operational status can result from failure in either the operating equipment or the static test equipment. Cause of failure and time of failure to be established, procedure to cure failure to be recorded. Type of failure to be noted either non operating failure or failure during test. Failure can be restored by repair or replacement. Time to repair to be recorded.

2. Establishment of Site TV Readiness Status

Assuming the site to be in operational status, prior to progamming reception, site readiness will be established by the following procedure conducted by the site operating team.

(a) Local climatic conditions to be determined i.e. temperature, humidity, precipitation, winds, etc, antenna physical condition to be classified i.e. undamaged moist, iced, etc.

(b) System power to be switched on, equipment power and classroom lighting.

(c) Measure with an rms voltmeter at the output of the receiver discriminator the rms noise power N

(d) TV receiver calibration - Programming source will transmit a calibration pattern consisting of a RETMA or other resolution chart and a standardized color pattern.

The antenna orientation will be checked to verify that it produces a maximum signal according to the built-in signal meter.

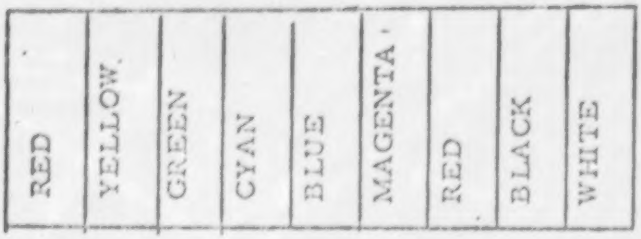
The peak to peak signal, S, at the output of the equipment discriminator is measured.

The ratio $^S/_N$ is formed. If it is greater than 1.6×10^4 reception is at TASO grade 1. If it lies between 5×10^3, and 1.6×10^4 reception is at TASA grade 2. The receiving TASO grade is recorded.

If the $^S/N$ is less than TASO grade 2 the site readiness status cannot be confirmed. This condition is recorded.

System resolution should be 250 TV lines horizontally and 350 lines vertically as indicated by the chart, at the center of the screen. The resolution provided can be determined visually or it can be recorded on a chart replica supplied. If the available resolution is not visually acceptable, the resolution provided should be carefully identified on the replica. The relationship between resolution and educational utility is not established, otherwise a lower bound to readiness could be set Resolution in the corners of the screen will be less than the center. The visual should verify the uniformity of the test pattern in the corners If it is not uniform visually, the display non uniformity should be marked on the replica of the test pattern. (the relationship between non uniformity and educational utility is not established). The RETMA resolution chart can also indicate disturbing non linearities in picture generation by visual observation of the lines. If this exists it should also be marked on the replica.

Programming source will transmit a standard vertical bar color pattern as shown below:



This pattern shows the red green and blue saturated primaries and their chromatic complements as well as black and white. In observing the color bar pattern the objective will be to establish a psychophysically perceived color presentation that is acceptable in terms of brightness, hue and saturation of the colors presented including black and white. Generally the color presentation is satisfactory if it is balanced and undistorted and noise free. If doubt exists, a replica of the color bar chart will be marked up with some agreed on notations to indicate the problem and the degree of doubt.

During this calibration period, any sources of extraneous picture distortions or displacements should be corrected if possible by adjustments in the antenna or in the controls of the TV monitor. Extraneous noise characteristics must be categorized and recorded. Suggested categories are ghosts, snow and RFI, although RFI may require further subdivisions.

It is assumed that if the TV video is functioning correctly, then the TV voice channel will also function correctly so that no separate measurements are defined for this signal.

3. Establishment of Site Interactive Voice, Voice Traffic and Data Traffic Readiness Status

This procedure is necessary only at those sites designated as either intensive or comprehensive. It should be conducted at the same time that the TV test patterns are being displayed. The procedure requires the establishment of voice intelligibility in a two way interchange between site and program originator, or between intensive and comprehensive sites, for normal speaking voices and a reasonable voice dynamic range. Since the voice connectivities are through ATS-1 or ATS-3, the testing procedures must be coordinated with these satellites.

Voice quality and intelligibility may be established either by transmission of a predetermined spoken program, reception of which is confirmed, or through the transmission of test tones. The former seems to be the simpler approach, but the choice will be made during the preliminary educational operating phase from July to September. It relies more on subjective evaluation than technical evaluation.

Since the equipment is installed and its power on condition verified, the procedure requires the transmission through the classroom microphone of a standardized spoken sample and the confirmation of received quality end to end.

4. The Alaskan Experiment

This particular experiment has an alternative mode from Denver via ATS-F to Fairbanks and then by some terrestrial interconnection to the experimental intensive sites. This connectivity will be calibrated as for other TV programming. The specialization, if any, required for this link cannot be determined at present because of the lack of definition of the terrestrial links.

5. Technical Evaluation during Programming

The procedures outlined above dealing with the calibration of voice links and voice/TV links are designed to establish satisfactory operation of the system just prior to programming material receipt. During the actual programming no further measurements will be made but it is advisable to have some qualitative observations recorded that could be significant to the acceptability of the programming material by students and teachers.

These qualitative observations relate to any annoying dynamics in the picture or noise in the sound. Their significance is measurable by their duration and by the time of occurrence in relationship to the material being presented. Since such disturbances can destroy concentration, negating the material in the presentation, it is considered necessary that the classroom teacher provide qualitative statistics on such events, their duration, an estimate of the event consequences, and of any attempts at correction.

6. Recording and Collection of Data pertaining to the classroom.

Data pertaining to the site calibration and evaluation during programming will be collected at each programming period. At this time it is not clear that recalibration will always be required. It will depend on previous history at the site and on the time interval between programming receptions.

A single chart is visualized for presenting all the statistics relating to a programming period at each site in the system. The content of the chart is shown in Figures 2.4 and 2.5: one side being used to identify conditions, the other side to indicate deviations from satisfactory conditions.

Details on the exact chart format will be developed during the preliminary period of the educational programming from July to September. The procedure for collecting the data will have to be arranged between ECON and those responsible for data collection.

The forms will be accompanied by an instruction manual which will be distributed along with the forms. The manual will explain the use of the form and contain illustrated examples of sample events and evaluation criteria. The feasibility of using a brief (10-15 min) segment of ATS-F transmission to explain the purpose of the technical evaluation and the use of the forms should also be considered.

Figure 2.4 Data Chart Side 1

	Confirmed	Unconfirmed		
Site Operational Status				
	Confirmed	Unconfirmed		
Site TV Readiness Status				
Classroom lighting				
Resolution				
Color quality				
TASO grade				
Extraneous noise				
	Satisfactory	Unsatisfactory		
Site Voice Readiness Status				
Voice quality				
Intelligibility				
Evaluation During Programming				
Events	Yes	No		
Duration (estimated)		Minutes		

Form No.
Observer
Date
Programming hours From To
Program No.
Site No.
Set No.

Overall quality evaluation	Excellent	Good	Passable	Poor

Figure 2.5 Data Chart Side 2

Operational Status Unconfirmed
Operating equipment failure
Test equipment failure
Mean time to repair

Component Action

Site Readiness Status Unconfirmed

Resolution
RETMA Pattern

Color
Bar Chart

Extraneous noise
Ghosts
Snow
RFI

Voice Quality Not Acceptable
Reason
Was voice used or not

Lack of Intelligibility Noise
Yes No

Evaluation During Programming
Description of event

Consequences of event:

Correction actions attempted:

3. COST AND ECONOMIC CONSIDERATIONS

The Health Education Telecommunications Experiment to be performed in 1974 using ATS-F will go a long way toward demonstrating and assessing the capabilities of satellite communications technology as applied to educational TV. It will also provide some insight into the type of operational system which is necessary to provide a continuing educational TV service. However, the desirability of satellite educational TV must be assessed ultimately in terms of economic criteria.

3.1 Cost-Effectiveness and Cost-Benefit Analysis

The objective of most new technology application programs is either to provide a new capability and/or to obtain a current capability at a lower cost. Satellite delivered educational TV programming, for example, can be accomplished in other ways using aircraft, cable and microwaves. Althoug identical data products may not then result, one can interpret the data delivered as a capability provided for education. Figure 3.1 shows that at given cost, various educational program delivery technologies may yield varying capabilities or alternatively, for a given capability, different data delivery technologies result in varying costs.

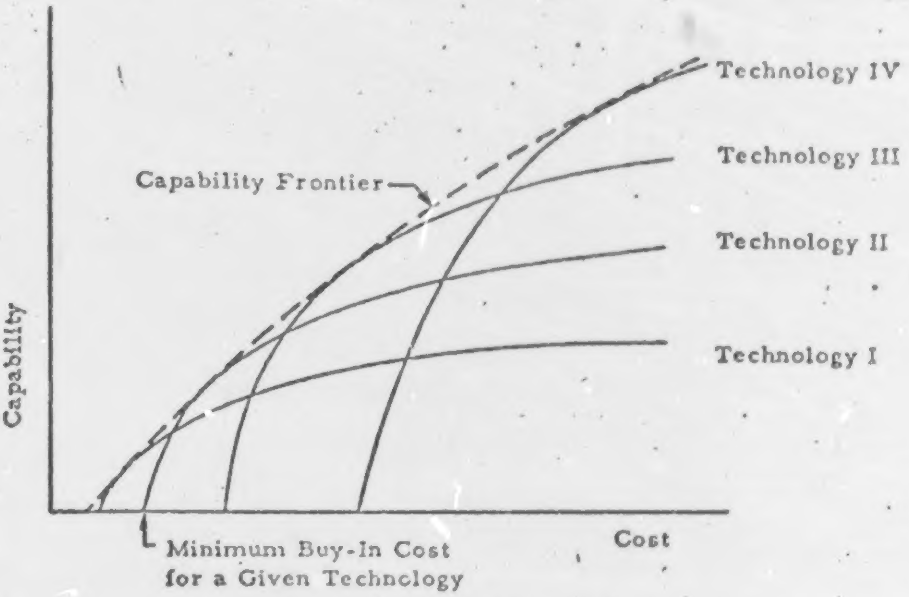


Figure 3.1 Capability-Cost Frontier

The fixed-cost limit of capability and the minimum cost technology for obtaining a fixed capability are defined by the capability frontier. The capability frontier is a technology boundary which defines cost-effective capability.

To obtain an estimate of the capability frontier is very difficult but, once this has been done, a major part of any benefit-cost analysis or economic evaluation is accomplished.

Once the capability-cost relation is known, one can ask, "What is the minimum cost at which one can achieve a given capability?" In Figure 3.2, this cost is read off at the intercept of the capability required with the cost-capability frontier.

On the other hand, in a fixed budget situation the question will be asked, "What is the maximum possible capability, the most one can do, with the funds allocated?" This answer is shown in the lower part of Figure 3.2 showing the same basic capability-cost frontier.

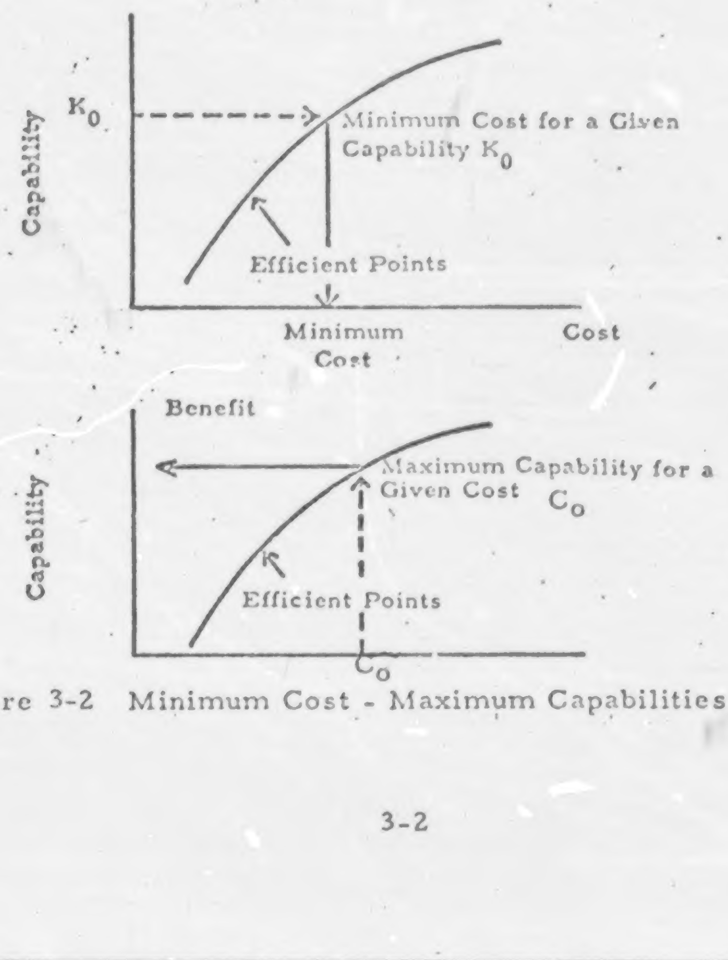

Capability
K0
Minimum Cost for a Given Capability K0
Efficient Points
Minimum Cost
Cost
Benefit
Capability
Maximum Capability for a Given Cost C0
Efficient Points
C0

Figure 3-2 Minimum Cost - Maximum Capabilities

These two questions lead to "equal capability" analysis, and to "equal budget" analysis of new technologies.

Figure 3.3 shows the effect of technological progression the capability-cost frontier. To progress over the present state-of-the-art one has to get more capability for a given cost or achieve a given capability at less cost.

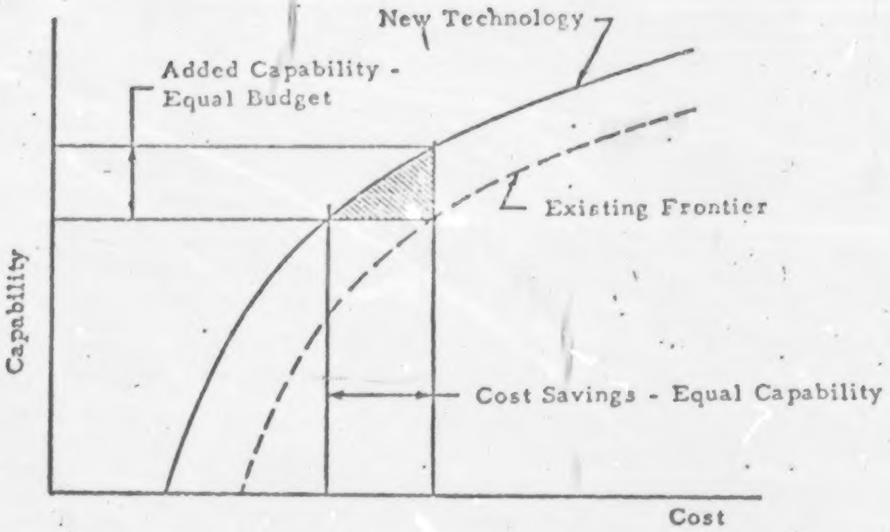

New Technology
Added Capability - Equal Budget
Existing Frontier
Capability
Cost Savings - Equal Capability
Cost

Figure 3.3 The Effect of Technological Progress on the Capability-Cost Frontier

In many situations it is possible to establish the economic value or benefit associated with each level of capability. Economic value of a given capability in this context is the value of the education which is made possible by that capability. As capability increases, benefits will also increase, but at a decreasing rate. In Figure 3.4, expected benefits are shown as a function of increasing technical capability. This form of representing benefits allows one to compare directly gross benefits and gross costs of new techniques. The shaded area in Figure 3.4 indicates how net benefits* change as technical capability is increased.

Now, given capability-cost and the capability-benefit curves, the next question is, how much should one invest to achieve the capabilities, hence benefits, offered by the technology? One standard answer is to maximize the benefit-cost ratio. In Figure 3.4 that maximum is shown at K_0. If one divides the gross benefit by the costs one incurs, and one maximizes the benefit-cost ratio, one gets an investment level of K_0. At this point the ratio is maximized. But just by looking at the diagram, one

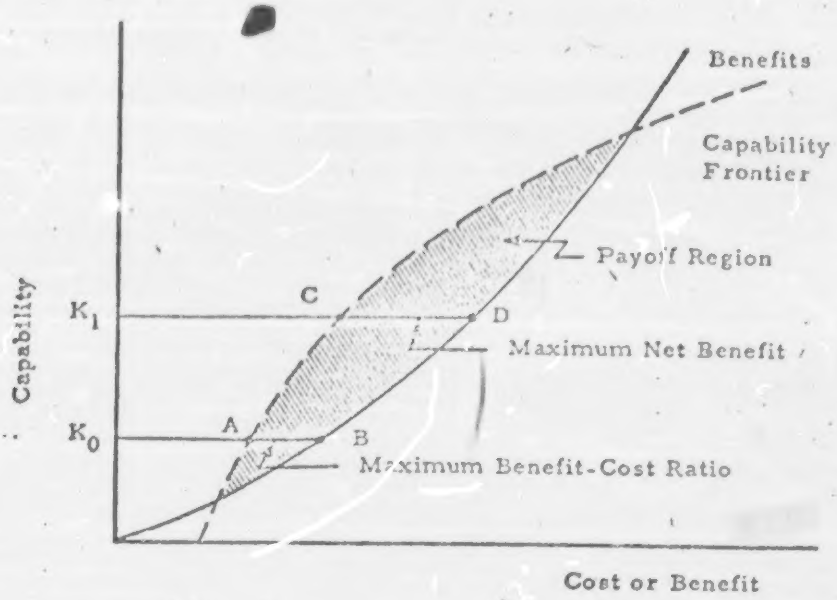


Figure 3.4 Benefit-Cost Relation

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*Net benefits are defined as the present value of benefits less the present value of costs.

sees that it is possible to realize a much larger absolute benefit, though at a smaller benefit-cost ratio. So the benefit-cost ratio is not really what one wants to maximize. Instead, if costs are not constrained, the criterion is to maximize the net benefit in absolute terms; that is, maximize the distance between the benefit and the cost curve. This point is shown in Figure 3.4 by K_1, the capability level of the line between C and D. It is different from the maximum of the benefit-cost ratio. The maximum net benefit is determined by just transposing horizontally the cost curve: where the slopes of both curves are the same the maximum is attained.

This rule, maximization of absolute benefits, can also be applied to a new technology system which expands present capabilities. However, even in this simple presentation the outcome of such an analysis can be quite varied. One outcome already discussed is where the system will produce at less cost more of the same capability; this is shown in Figure 3.5. The original point of tangency at C is now shifted up to the point E and the benefits derived from the new capabilities are EF. The cost of achieving that capability is reduced from C_0 to C_1. The return in technical payoff capability, is increased from K_0 to K_1. There is no conflict between either more capability or less cost. By maximizing absolute net benefits one gets a combination of both. We select actually one particular point of the set of all possible points shown in the shaded area of Figure 3.3.

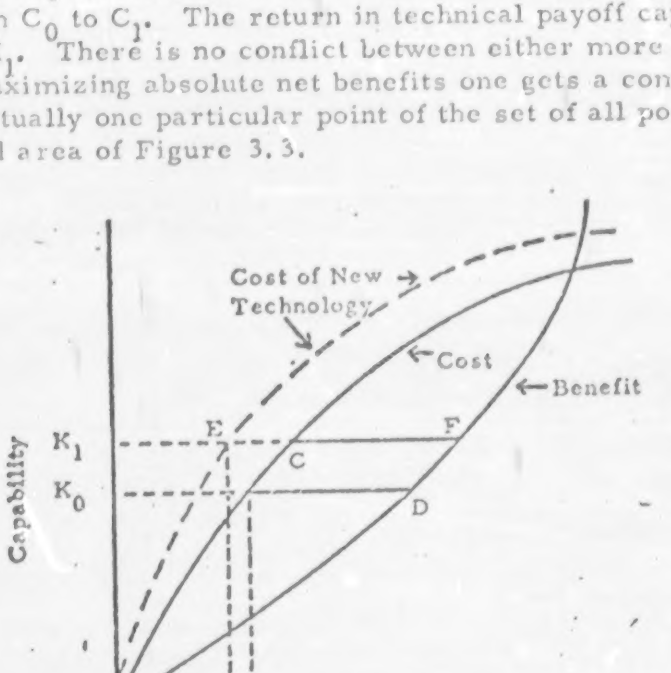

Figure 3.5 New Cost Capability Relation

However, by maximizing benefits we also can get a result that, by cost-effectiveness standards, seems paradoxical: to achieve the new technology we should increase the budget to get added capability. If technological progress is such that it favors large scale systems, it often happens that when a new system is introduced, one not only will get increased capability but one does so at an increased cost level, above and beyond what originally was invested. Such increased costs may be justified by increased benefits; cost effectiveness alone could never yield such a result, see Figure 3-6.

Because of the problems associated with establishing the benefits of education associated with different levels of capability and the fact that the primary objective of this analysis is to evaluate educational capabilities of satellite-based services, it is felt that current economic analyses should be limited to the equal capability and/or equal budget approaches (i.e., cost-effectiveness analyses). The limitations of this approach, as pointed out above relative to the more general benefit-cost approach, should be kept in mind.

3.2 Economic Considerations

The economic analysis of educational services involves cost patterns that occur over many years (see Figure 3-7). These costs include both recurring costs and non-recurring costs. The recurring costs include the costs of operating and maintaining the educational services and the non-recurring costs include the costs of establishing the educational services. The non-recurring costs therefore include the design, development, test and engineering costs as well as all other investment costs. When different alternative courses of action yield different cost patterns over a period

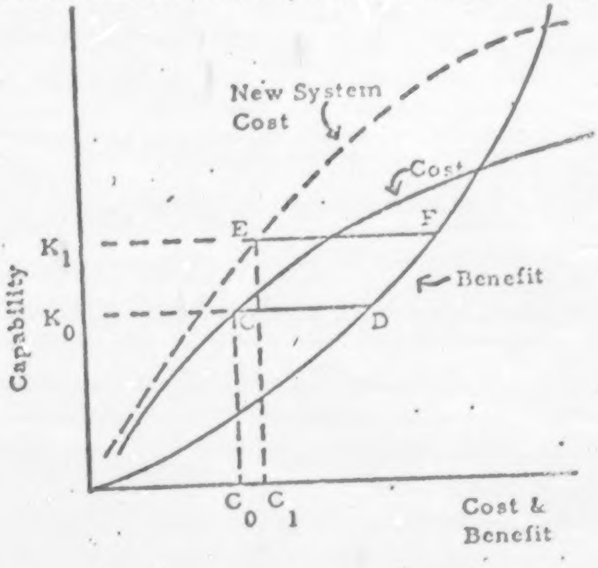

Figure 3.6 Increased Capability and Cost

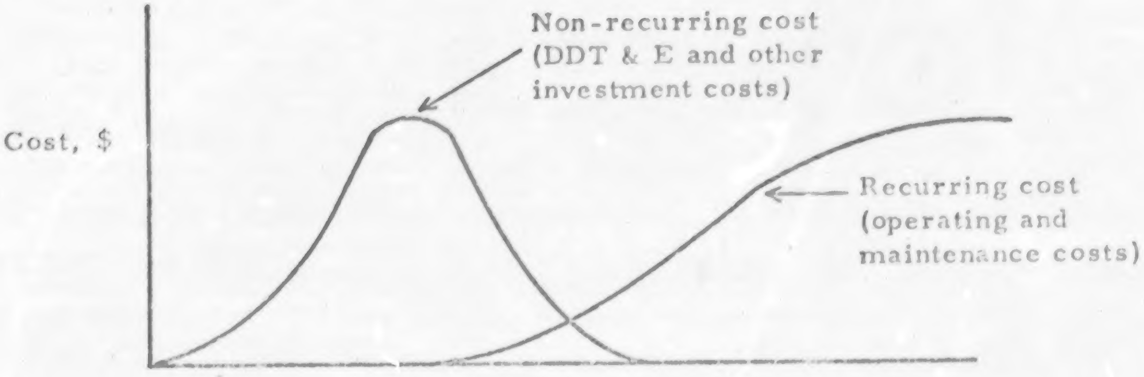

Figure 3.7 Typical Cost Patterns

of time it is desirable to present the results of the economic analysis in terms of the present value of costs. The present value, which explicitly takes into account the magnitude and the timing of the cost patterns, is defined as the summation of future annual costs discounted to the present and is given by

$$PV = \sum_i \frac{C_i}{\left(1 + \frac{r}{100}\right)^i} \qquad (1)$$

where PV = present value of cost, C_i = cost in the i^{th} year, and r = discount rate (%) or cost of capital. In the world of certainty (the situation involving uncertainty and risk will be discussed later) and in an equal capability situation, it is desired to determine that alternative which minimizes the present value of costs.

It is not possible to assess the cost of satellite based or other types of operational educational services until the desired educational services are specified. The services or capability desired, for example, interactive TV, can have a significant effect upon operational system technology, configuration and cost. Of course a typical approach of systems analysis is to provide results in parametric form so that trade offs between cost and capability become apparent. In order to make parametric analysis a practical reality it is still necessary to place bounds upon the capability levels to be considered. If different capability levels are to be considered in the economic analysis and cost estimation process it is important to develop concepts for establishing the relative value of the different capabilities -- this in turn leads to the benefit-cost approach.

Two aspects of cost need to be considered, these being (a) the cost of the Health Education Telecommunications Experiment to be performed in 1974 using the ATS-F satellite, and (b) the cost of providing an operational educational service based upon satellite technology. The former cost is of interest primarily as an aid in the estimation of the latter cost. The latter cost is important since it will, when compared with the cost of other methods of providing the educational services, determine the desirability of satellite technology based systems.

The costs associated with the telecommunications experiment can be categorized as follows:

(1) Space costs including satellite costs, launch costs and operations costs,

(2) ground equipment costs including receiving, transmission and test equipment costs,

(3) TV program production costs, and

(4) instruction (classroom) costs.

The above costs can be aggregated according to the type of service provided during the experiment. It is felt that these costs, with the exception of the space costs, can be projected, in terms of fixed and variable costs, to give insights into the costs that might result from operational systems having different levels of capability.

The ATS-F educational project will be an experimental demonstration, optimized within the educational objectives of the experiment employing current satellite technology. Its degree of success in meeting educational and technical objectives will then establish a baseline set of educational networking characteristics, after evaluation, which will form the substantive basis for future educational network developments. It is highly unlikely that an operational TV education system based upon satellite technology would evolve prior to the early 1980's. The question then remains as to the significance of currently obtained satellite cost data for projecting satellite costs in the 1980's. It is felt that current satellite and related costs should not be used or simply extrapolated for estimating 1980 satellite system costs. The reasons for this follow.

The ATS-F satellite will be launched on an expendable launch vehicle. The satellite design is such that it is constrained by the launch vehicle capability, for example, mass, length, diameter, g-loading, etc. Its design concept is such that once placed in orbit the satellite cannot be recovered and/or repaired. These factors have a profound influence on satellite cost, both non-recurring and recurring. During the early 1980's the Space Shuttle Transportation System will become operational. This implies that satellite systems which will operate during this same time period will most likely utilize the Shuttle System. The Shuttle System will significantly reduce the mass, length, diameter, g-loading, etc., constraints. The shuttle system will also make possible significantly different satellite design concepts by making possible spacecraft standardization, low cost spacecraft designs (1-4), in orbit check-out of satellite performance, space based servicing and repair, and recovery and repair of satellites. Recent studies (1-5) indicate that the new operational capabilities can significantly effect satellite cost thus making projections based upon current technology rather unreliable indicators of future system cost.

If education system capabilities can be specified then operational systems based upon satellite technology can be formulated and costs assessed. There are many computerized cost models(1, 6, 7)* that evolve cost estimates, at the subsystem level, for both recurring and non-recurring costs. The cost models typically consist of a set of independent cost estimating relationships (CERs) based upon a collection of historical data. These CERs are, in general, non-linear multi-variable equations which relate subsystem costs to performance and physical characteristics. Typical inputs include such features as size, mass, type of componentry, power dissipation, construction type, as well as the prototype and production quantities. The LMSC cost models(1) take into account the effect of relaxed mass constraints (as per the Space Shuttle) upon costs.

The CERs provide estimates of satellite unit recurring and non-recurring costs. These costs can thence be used as inputs to an analysis which considers the operational aspects of the mission. Recent analyses (8-10), described in the following pages, indicate how these costs, plus other data, are used in evaluating total annual cost associated with the mission and the present value of the mission costs.

An operational education system based upon satellite technology may be referred to as a "service" mission. A service mission typically consists of two phases, namely the establishment of a desired level of service and the maintenance of that level of service. The establishment of the service is concerned with successfully placing a number of satellites in orbit over a period of time as determined by service needs. If it is assumed that the need is known (and that the capability of the satellites is known), it follows that the number of satellites required to establish the service is deterministic. The maintenance of the service is concerned with maintaining the desired number of operational satellites in service. As a result of less-than-perfect reliability and variability associated with wearout phenomena, such as attitude control gas depletion, satellite failures will occur in a random manner with the result that the traffic associated with the maintenance of the service will be known only in a probabilistic sense. The probabilistic nature of the traffic due to satellite failures and replacements adds an important degree of uncertainty and risk (defined as the chance that key performance indicators such as present value reach or exceed different levels) to the service mission. It is, therefore, necessary to consider the impact of satellite reliability on the overall mission.

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*Other models have been developed by Washington University (Modified Stamp), NASA, Computer Science Corp., and others.

Another contributor to risk is the less-than-unity reliability of the Space Shuttle Transportation System, its various mission modes, and failure recovery possibilities. Cost uncertainties also directly affect the risk associated with the service type mission. The explicit consideration of uncertainty and risk is important particularly, as in the present case, when the different alternatives which are to be compared are in various states of research, development and production.

To illustrate the analysis of a service mission a typical mission was evaluated and the risk profiles of annual costs, number of events (i.e., number of launch attempts, number of satellite refurbishments, etc.), and present value of cost were established. Only recurring costs were considered. (Non-recurring costs must be added in the current analysis as well as programming and instructional cost. These latter costs can be extrapolated from the cost data obtained from the Telecommunications experiment.) The mission is concerned with placing two satellites in orbit during each of the first three years of operation and thence maintaining six operational satellites in orbit for an extended period of time. It is assumed that the satellites are designed to achieve a mean-time-before failure of 10 years and an expected wearout life of 5 years. It is assumed that operational uncertainties imply a one-year standard deviation of wearout life. Other parameters used in the analysis are summarized in Tables 3.1 and 3.2.

The analysis utilizes a simulation (Monte Carlo) model which mathematically describes the operational, cost and economic factors associated with the mission. The model is illustrated in Figure 3.8 and consists of three mathematical models:

TABLE 3.1*

Reliability Aspects Considered

-Shuttle/Tug Payload Placement & Retrieval Mission-

Probability of Success for	Estimated Values** as a Function of Time from start of Analysis, years			
	1	2	3	4
Booster burn	.99	.992	.994	.994
Booster recovery given booster+ success	.93	.94	.95	.95
Booster recovery given booster failure	.40	.45	.50	.50
Orbiter recovery given booster failure	.97	.98	.99	.99
Orbiter achieves low earth orbit	.99	.994	.998	.998
Orbiter recovery given abort to orbit	.97	.975	.98	.98
Orbiter recovery from low earth orbit	.99	.995	.999	.999
Space Tug checks out successfully in low earth orbit	.97	.975	.98	.98
Space Tug transfers to satellite placement orbit	.98	.984	.988	.988
Space Tug transfers from terminal orbit to low earth orbit and rendezvous with orbiter	.98	.984	.988	.988
Space Tug docking with satellite to be returned	.97	.975	.98	.98
Satellite check-out in terminal orbit	.97	.975	.98	.98
Space Tug reacquiring satellite which does not check-out in terminal orbit	.98	.985	.99	.99
Probabilities not shown are assumed to be high				

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[*] From Reference 10

[**] Estimates for years 3 and 4 are similar to those appearing in Reference 5.

[+] Space Shuttle Transportation System consists of solid rocket motor booster, Space Shuttle Orbiter and Space Tug.

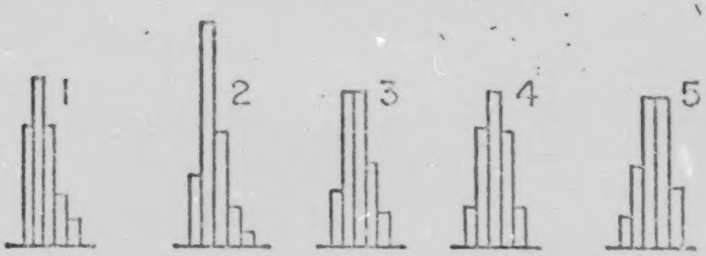
TABLE 3.2[*] Cost Components & Nominal Values (Millions of Dollars) and Uncertainty Estimates

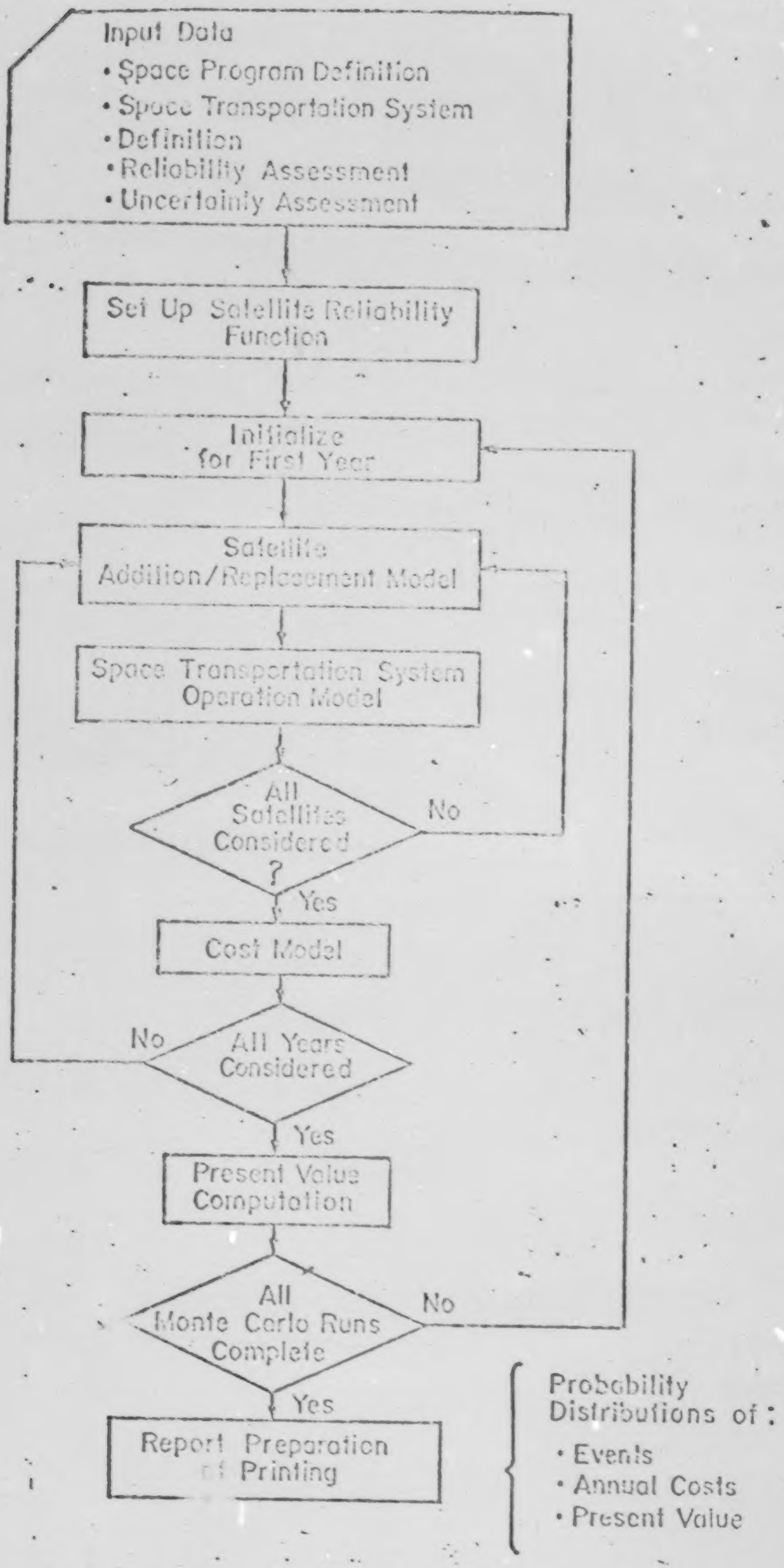
Cost Component	Nominal	Uncertainty Estimate		
	Value	Minimum	Maximum	Pdf+
Booster expendable cost	3.5	3.1	5.25	3
Booster reusable cost	5.5	5.0	6.0	4
Booster refurbishment cost	1.0	.8	1.8	3
Orbiter expendable cost	2.2	2.0	3.0	3
Orbiter reusable cost	300.0	250.0	350.0	5
Orbiter refurbishment cost	3.7	3.0	4.5	3
Space Tug expendable cost	.01	.008	.011	3
Space Tug reusable cost	18.9	15.2	28.5	3
Space Tug refurbishment cost	.38	.3	.57	1
Satellite cost[**]	20.0	15.0	28.0	3
Satellite refurbishment cost[**] (% of satellite cost)	15.0	10.0	20.0	3
Operations cost/flight	.15	.12	.17	2

[*] From Reference 10.

[**] Based upon a satellite retrieval capability. It is assumed that when a satellite is not to be retrieved its cost can be reduced to $16 million.

+Uncertainty profiles (Pdf)





Input Data
• Space Program Definition
• Space Transportation System
• Definition
• Reliability Assessment
• Uncertainty Assessment
Set Up Satellite Reliability Function
Initialize for First Year
Satellite Addition/Replacement Model
Space Transportation System Operation Model
All Satellites Considered ?
No
Yes
Cost Model
All Years Considered
No
Yes
Present Value Computation
All Monte Carlo Runs Complete
No
Yes
Report Preparation of Printing
Probability Distributions of:
• Events
• Annual Costs
• Present Value

Figure 3.8 Simulation Model for Evaluating Effect of Reliability and Cost Uncertainties (from Ref 10)

1) A Satellite Addition/Replacement Model which establishes the number of satellites that must be added or replaced as a function of time based on the satellite reliability function. This model keeps track of each satellite to establish if and when a failure occurs and, based upon the operational requirements, determines the number of satellites which must be added and/or retrieved and refurbished.

2) A Space Transportation System Operational Model which simulates the events that take place during the process of placing and retrieving satellites from orbit. This model takes into account the various reliability aspects denoted in Table 3.1 and the resulting failure and recovery possibilities and establishes the probability distributions of pertinent events (for example, the probability distributions of launch attempts) which result from the success and failure situations. The nominal parameters are varied so that the effect of satellite reliability and Space Tug retrieval capability on the events, cost and present value of cost can be evaluated.

3) A Cost Model which, utilizing cost learning curves, cost spreading functions, etc., establishes the recurring costs of the various events including replacement and refurbishment costs for the Space Shuttle, Space Tug and satellites. The cost Model combines the results of the operational analyses (1 and 2) with the appropriate cost per event. The cost data is then used to establish the present value of costs for the entire program.

A typical probability distribution of the number of required launch attempts is illustrated in Figure 3.9. It should be noted that if failures did not occur, only two launch attempts would be required; in fact, there is a 50% chance of exceeding two launch attempts and about a 20% chance of exceeding three launch attempts. The importance of this and other event probability distributions is that they impact costs. The cost probability distributions are a function of cost uncertainties and the uncertainty associated with the number of events.

The annual cost uncertainties in turn lead to risk in terms of annual costs exceeding budget constraints. The cost uncertainties can be summarized in the form of the risk profile of the present value of recurring costs as illustrated in Figure 3.10. Figure 3.10 shows the probability of the present value of recurring costs exceeding various levels. The present value risk profiles, based upon the nominal data in Tables 3.1 and 3.2, are illustrated for the situations where a satellite retrieval capability exists and when it does not exist. Also shown are the present values associated with the uncertainty situations. The certainty situation assumes satellites fail at the anticipated wearout time and are thus retrieved and/or replaced. Note that there is a 50% chance that present values can exceed those of the certainty

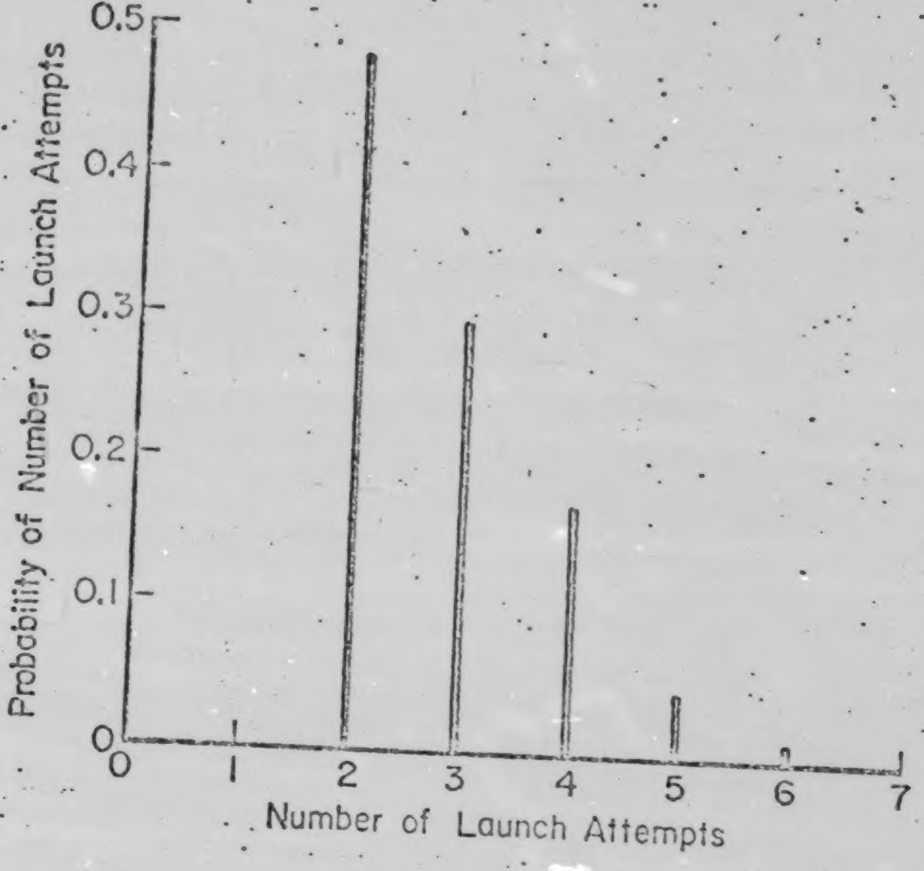


Figure 3.9 Probability Distribution of Launch Attempts in Year 3 (from Ref. 10)

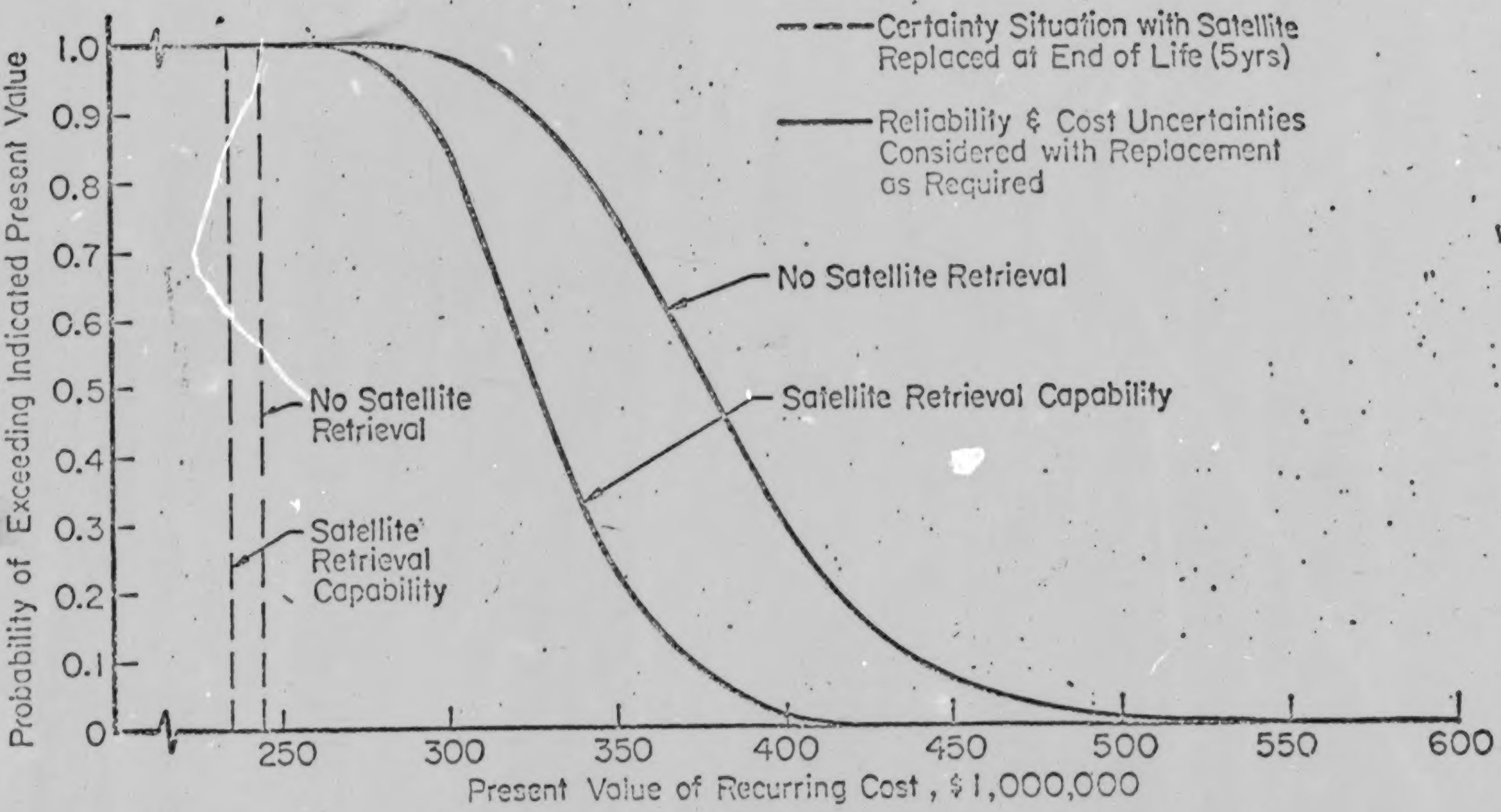


Figure 3-10 Probability Distribution of Present Value of Recurring Cost at a 10 % Discount Rate (from Ref. 10)

cases by more than 40 - 50%. It should also be noted that the expected present value and risk are increased when satellite retrieval and refurbishment are not possible. The importance of an analysis which explicitly considers reliability and cost uncertainties is apparent! It leads to more realistic cost estimates and allows the chance of exceeding various budget levels to be determined. There can be significant differences between the program costs and present values when developed with and without the explicit consideration of less-than-perfect reliability and cost uncertainties. In general, optimistic costs are obtained when reliability and cost uncertainties are not explicitly considered.

Systems based upon aircraft, cable television, microwave and other technologies are possible and can be configured once the desired capability is specified. The total annual costs, that is both recurring and non-recurring costs, associated with the different alternatives must be established. The costs associated with these other alternatives can either be developed from the "bottom-up" based upon a detailed specification of the subsystem hardware and cost estimates based upon experience, or cost models such as the RCA PRICE (7) system may be used to assist with the cost estimation. As in the case of an education system based upon satellite technology, the unit recurring and non-recurring costs must be placed in the context of an operational system and total annual costs developed for the life of the system. These costs must include all of the costs associated with providing the same level of capability as that provided by the satellite technology (i.e., the equal capability approach) and should include maintenance and replacement costs, operations costs, etc. Programming and instructional costs must also be included. It is possible that to a reasonable degree these latter costs may be extrapolated from the cost data obtained from the Telecommunications experiments.

Once annual costs for systems based upon alternative technologies have been developed it is possible to compute (as per equation 1) the present value of the costs of each alternative. As a very minimum it is necessary to compare the expected net present value of the costs of various alternatives so that the system yielding the minimum net present value of cost can be ascertained.

Great care must be exercised in establishing expected net present value. If most likely costs are utilized in the analysis process, total annual costs and present values are probably underestimated. Expected costs should be used particularly when it is anticipated that the probability distributions of costs are skewed (that is, the most likely and expected values differ). The effect of most likely vs. expected cost is discussed in

References 10 and 11.

Since the alternatives to be considered are in various stages of research, development and production, different levels of confidence will exist in the cost estimates. These confidence levels can be expressed in terms of ranges of uncertainty associated with each of the key variables associated with the differenct systems and subjective estimates of the chance of the variable achieving the different values within the range of uncertainty (i.e., the uncertainty profile or probability distribution of the uncertainty variable) can be made. Monte Carlo simulation (Risk Analysis) techniques can be used to appropriately combine the uncertainties associated with the input data to yield the risk profiles associated with the alternative. (8-14)

As a direct result of the consideration of uncertainty, the costs used in equation 1 are not deterministic quantities. Thus the present value of costs should also be characterized by a probability distribution. The probability distribution represents the chance of achieving each of the possible levels of present value. The probability of present value exceeding a specified level may be determined by obtaining the area under the probability distribution curve for all values greater than the specified level. This is normally referred to as the cumulative probability distribution (henceforth referred to as a risk profile). Typical risk profiles of present value are shown in Figure 3.11 where the vertical scale represents the probability or chance, p, of exceeding the various levels of present value, PV, indicated by the horizontal scale. In general, the steeper the curve, the lower the risk (or variability). When comparing alternatives, it is important to compare the expected or most likely present values. It is equally important to also compare risk levels.

Figure 3.11 illustrates the risk profiles of present value for two hypothetical alternatives, A and B. It should be noted that the expected (p = .5) or most likely* present values of the two alternatives are equal. A decision maker performing a traditional analysis usually evaluates only the most likely present value. To this uninformed decision maker, alternative A and B "look alike".

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*Since present value probability distributions generally tend to be normal, the expected value and the most likely value are approximately the same.

In the certainty situation, it is generally desirable to select the alternative which yields the minimum present value of costs when all alternatives are evaluated on an equal capability basis. When presenvalues are equal, the choice is immaterial. The selection process becomes more difficult when uncertainties are considered; trade-offs must be made between alternatives possessing different expected present values and associated levels of risk. When the risk dimension is available, alternatives A and B are found to be quite different. The risk (the variability) associated with alternative A is greater than tha associated with alternative B. Thus, a conservative decision maker* would normally select alternative B provided that other, unquantified pressures to select alternative A do not exist.

The problems of comparison of alternatives are eased somewhat by the fact that the probability distributions of the present value of costs are usually very nearly Gaussian. Thus, the distributions can be fully characterized by their mean, m, and standard deviation, σ, and each alternative can be represented by a point on the m-σ plane. An example is illustrated in Figure 3. 12. Here alternatives 1 and 2 have the same level of risk (i. e., $\sigma_1 = \sigma_2$) but the expected PV of the cost of alternative 2 is greater than that of alternative 1. Therefore alternative 1 is preferable to alternative 2. In a similar manner, it can be argued that alternative 3 is preferable to alternative 4. Also, in a similar manner, alternative 3 is preferable to alternative 1 since both have the same expected PV but alternative 1 is riskier**. This process can be continued with all alternatives being considered.

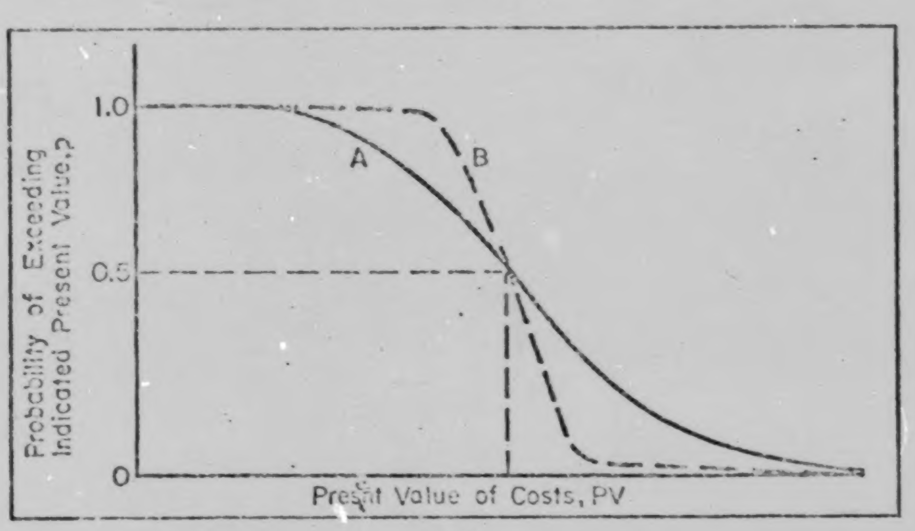

Figure 3.11 Risk Profile of Present Value

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*Conservative in the sense that risk aversion preferences are evident.

**This assumes a rational risk averse decision maker.

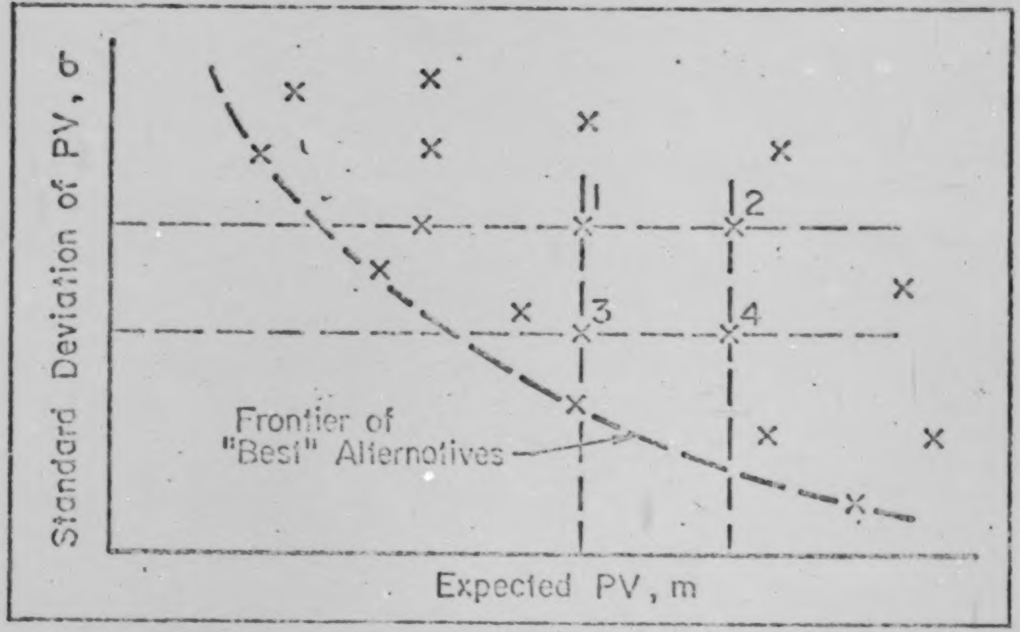

Figure 3.12 General Problem of Decision Making Under Uncertainty

In the limit, it can be seen that a frontier of "best" alternatives can be established. Each of the points or alternatives represented by the frontier are different in the respect that the risk and expected PV are different. The class of best alternatives has thus been obtained and the "best" alternative can then be selected based on the decision maker's risk judgement. That is, the decision maker must decide what the trade-off is between a reduction in expected PV of cost and an accompanying increase in risk.

The risk judgement may be purely intuitive or it may be based on a quantified utility function (15-17). In either case the trade-off between expected rewards and risk is made explicitly clear to the decision maker.

The previously discussed concepts and techniques, ranging from the use of cost estimating relationships to risk analysis, have direct application to the analysis, evaluation and comparison of alternative technologies for providing various types of education services. The appropriate techniques and concepts must be selected and used in the economic analysis in order to assure highly credible results.

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4. STATEMENT OF WORK

It is proposed to perform the following three tasks:

4.1 Technical Performance Task

The general objectives of this task are to:

a. Identify, describe and quantify the technical delivery performance of the ATS-F Educational Experiment

b. Apply the characteristics of the technical delivery performance to cross correlation with measures of educational utility to either validate or weight these measures

c. To interpret the characteristics of the technical delivery performance in terms of operational educational networking

The experimental nature of the ATS-F program both in its technical application and its educational applications implies that technical delivery performance must be examined and evaluated with a variety of objectives in mind. Examples of objectives are the determination of the effects of latitude and satellite antenna beam displacements upon technical performance and educational applications.

The subtasks required for this task are listed below:

Data Evaluation Objectives

A structure of objectives to be evaluated by data from the experiment will be developed. The objectives will relate to the technical experiments and the educational experiments.

Specification of Data

Data from each possible class (spacecraft, calibration, classroom) will be specified as it is appropriate to the data evaluation objectives.

Data Requirements

The quality and quantity of data required to perform each data evaluation objective will be analyzed and specified.

Data Recording Format

A data recording format will be developed that will facilitate correct data assembly and data completeness for calibration and classroom collected data. It will also include familiarization with the data recording format and interpretation of NASA recorded data.

Data Collection Methods

Since on-site data collection will not be performed by ECON personnel, the methods and procedures by which data will be collected will be formulated in a set of instructions for each data evaluation objective. It will also cover the procedure by which the data is made available to ECON for analysis and evaluation.

Data Analysis and Evaluation

Data received will be analyzed and evaluated. Manual and computerized procedures will be developed by which all relevant statistical descriptions of the experiment's impact on the objectives of Task 1 can be extracted from the valid data collected.

Technical Performance Report

A complete report will be prepared which will summarize and fully document the data obtained, the data accepted, the analysis and processing employed, results obtained and their validity. It will also summarize the impact of the results obtained on operational educational networking systems.

4.2 ATS-F Educational TV Experiment Cost Disaggregation

This task will result in the acquisition of all cost data needed to disaggregate ATS-F costs into the Educational TV Experiment costs. This task will consist of a data requirements determination phase wherein all appropriate desired cost data will be identified and procedures determined which will insure that the necessary data pertaining to costs to be incurred during the experiment will be collected properly and not lost through aggregated accounting procedures. Costs which have been incurred prior to the start of the experiment will be collected and disaggregated to the level either required by the analysis or the level allowed by the accounting procedures. If the disaggregation is limited by the manner in which data was collected, costs will be interpreted and apportioned as deemed necessary. The cost data will be disaggregated in two ways. Firstly, the actual cost of performing each of the experiments will be developed in a typical accounting sense. All costs will be apportioned according to duration of experiment, mass (satellite) of subsystem equipment, and other factors. Finally, the costs will be disaggregated and restructured so that the cost of providing different educational services or capabilities can be assessed. It should be noted that the former costs represent historical costs whereas the latter costs represent projections, based upon historical data, of the costs which might be incurred for each type of service or capability. The latter cost determination will be emphasized since the resulting costs will be used in the planning and assessment of future services and resulting systems.

The result of this effort will be a report which summarizes the methodologies, the basic data before and after disaggregation, and the computed costs associated with the different experiments and services.

4.3 Economic Analysis

The objective of this task is to assess the cost and present value of systems based upon satellite technology and to compare these with the costs and present values resulting from providing the same capability with other technologies. Based upon specified education services and desired capabilities, systems based upon satellite technology will be configured, analyzed, and evaluated and annual costs and present value of costs will be obtained. The costs and present values will be based upon the use of appropriate cost estimating relationships for both space and ground equipment. Satellite and launch system reliability and pertinent cost uncertainties will be considered and economic models will be developed by utilizing and appropriately modifying existing models. Trade-offs between space and ground systems will be performed so as to minimize the net present value of costs of providing the desired capabilities. Total life cycle system costs will be considered and will include educational programming and related costs. It is assumed that the educational program and related costs will be supplied to ECON.

Similar analyses will be performed for equal-capability systems based upon aircraft, microwave and CATV technologies.

The result of this effort will be a report which summarizes the methodologies and techniques employed, the basic data and assumptions, and presents the results of the analyses in parametric form. The various alternatives will be compared taking into account, as deemed necessary, expected values and risk measures.

4.4 Performance Schedule

The schedule for performing these tasks is discussed in Chapter 5.

5. WORK PLAN

The following work plan assumes receipt of contract 1 June 1974.

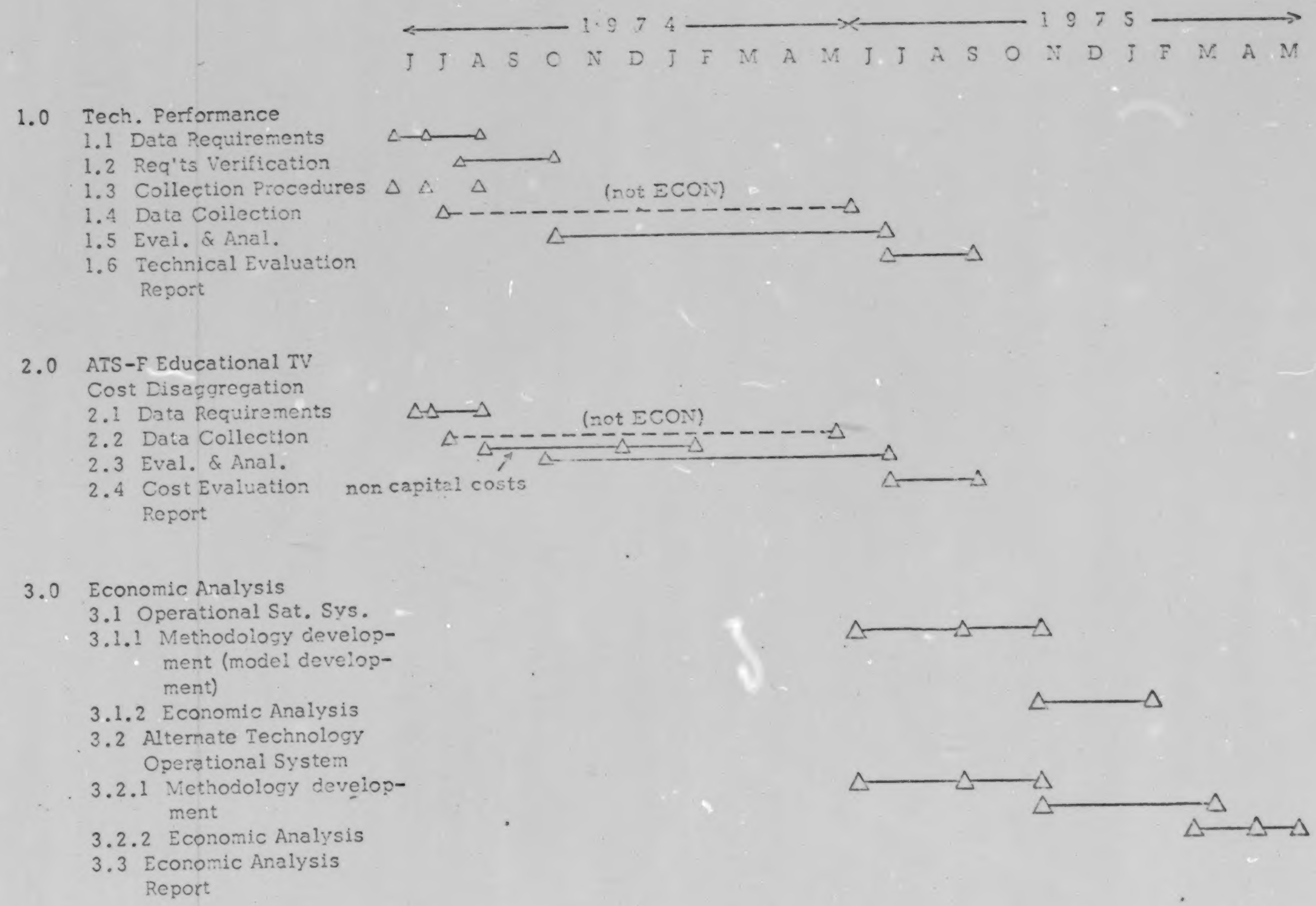


Figure 5.1 Work Plan (assuming contract award 1 June 1974)

SECTION X

PROJECT ORGANIZATION AND MANAGEMENT

Organization and management of the recommended evaluation activities presents some special problems in ensuring that (1) a complex piece of work gets performed and, (2) without unduly complicating the issues further, a diversity of viewpoints and skills are brought together. We have reconciled these needs in the project organization shown in Figure 4-1.

1. PROJECT DIRECTION AND MANAGEMENT

When we started this study we felt that some of our core PCI staff - e.g., Messrs. Rosenberg, Schmidt and Turner - supplemented by our colleagues at ECON Incorporated (whose business is economics of satellite communication) - had a sufficient grasp of the technology that we could relegate the technological aspects of this study to secondary and possibly tertiary importance. However, as we analyzed what needed to be done - particularly in terms of extrapolating ESCD experience to more plausible regional communications capabilities - it became clear that some of the major questions to be addressed by the study were not answerable within the confines of the study itself. For example, although the cost of satellite communications is clearly an issue of immediate and in fact paramount importance, the ATS-F is hardly representative of an operational communications system. The two-hundred million dollars or so that are invested in the ATS-F bird are not the probable configurations that the educational community will or should have available.

Fifty foot steerable antennas are not the probable prototypes of operational communications capability, and given the normal and reasonable reluctance of local schools to invest in technology, the study had best address itself to the ATS-F experiences that will help to formulate policy for utilization of satellite capabilities that we can reasonably expect to be forthcoming. And, certainly, satellite communications are forthcoming. The question before us is what are the proper roles (if any) for the educational community and HEW in utilizing that capability.

We expect that in Alaska, satellite capability will become a way of life almost immediately after this experiment, with the first steps in that direction initiated through utilization of the Canadian satellite (ANIK). We expect mainland U.S. experimental and operational investments to be made in the CTS, with launch currently scheduled in June of 1976.

Thus, it is clear that the manager of this project should have a good grasp of the numerous satellite and telecommunications activities that will be on-going in the period directly following the experiment, and over the next decade.

Our proposed Project Manager is Dr. Albert Feiner, formerly Director of the Lister Hill National Center for Biomedical Communications, National Library of Medicine, and with an outstanding career preceding that in the management of the various high technology (especially satellite) development projects for Magnovox, Hughes, etc. Dr. Feiner joins PCI on May 28.

To ensure that the findings of our study are tested against the touchstone of the feasible and probable permutations of the technology - which after all is what the demonstration is all about - we have selected as Project Manager a man whose experience and skills relate directly to that area of interest.

We are certain that Dr. Feiner, as Project Manager, can usefully and effectively integrate the findings of our study in a manner that will allow us to understand the educational community's demand for educational services, to select optimum strategies for satellite utilization, and through his extensive knowledge of alternative users of that technology, provide insights into the way that demand can be aggregated to serve national as well as local needs. Surely, if AT&T has decided that satellite communications are a preferred alternative for long lines communication in an excess of 1200 miles, such marginal users as the educational community, the health community, etc., can be expected to adopt comparable technological alternatives where and if they have applications requiring long line or mass distribution communications.

Dr. Feiner is capable of making a "best case" for satellite communications for education. Although we probably could rely upon his innate skepticism to provide a balanced view on the subject, we are not willing to accept his management direction without ensuring that there are important checks and balances built into the project itself. For this reason, PCI's Chief Executive, Mr. L.J. Rosenberg, has been charged with responsibility for what we call in Figure 1 "NIE's R & D Policy." Mr. Rosenberg's initial position with regard to the ESCD was that NIE has been sold down the river and was wasting its money chasing a demonstration that may have been important to many people, but had little importance to educators. We think he has modified this view somewhat, but his preoccupations currently are with issues that may strike some as overly recondite - impact on organizations in terms of retrospective studies, examination of alternative futures, overall policy as to how and why NIE should relate to other experiments, and an evolutionary view of what happens to organizations as they attempt to accomodate to the technology. In the role we have cut out for him, he will certainly challenge any tendency of the project team to respond with a justification of satellite communications as opposed to an objective analysis.

Our alternative choice for Project Manager was Dr. Roger Popper - a psychologist who cares very little for the technology as a technology, and has an intense interest in how, whether and why people and organizations are affected by that technology. Dr. Popper, as indicated in Figure 1, has been given the responsibilities for "measurement and analysis." In terms of basic study content, Dr. Popper is still Technical Director of the evaluation project, based upon his keen insight into the issues involved. He is, however, through the neat little lines on our chart, forced to subject himself to a variety of checks and balances, including Dr. Feiner, Mr. Rosenberg, Ms. Hageboeck, Dr. Posner, and what we call the "Gatepost Group." Dr. Popper's value as Technical Director is greatly enhanced by his experience with cross-cultural situations.

2. THE "GATEPOST GROUP"

The "Gatepost Group" is a group of individuals and organizations who provide access to points of view that are relevant to but not conventionally within the mainstream of the study - serving as "gateposts" to the world outside the study. The "gateposts" that we have identified for this project include some who see the large-scale communications as a way of homogenizing our population, thus destroying individual effectiveness and perhaps liberty (Mr. Andy Horowitz might argue this position), individuals vitally involved in the utilization of diverse technologies for education (e.g., Mr. Ronald Randall), individuals concerned with alternative modes of telecommunications capability (e.g., Mr. Bowman Cutter, head of the cable television activities within the Urban Institute), and such formally constituted groups as the Joint Committee on Telecommunications and Education. Such "gatepost" individuals will be invited to our periodic (generally monthly, always quarterly) project reviews, to ensure that our study approach both takes into account a diversity of opinions, and that our study results will be useful, if not convincing, to a diversity of views.

3. ECONOMIC AND COST ANALYSIS

The economic and cost analysis portion of our study will be directed by Dr. L.D. Posner, a savvy evaluator with special credentials in the cost effectiveness of alternative educational techniques.

4. REGIONAL EVALUATION SUPPORT

The regional evaluation support functions will be managed by Ms. Molly Hageboeck, who has special experience of direct relevance to this project, based on her concurrent management of PCI's activities to make an educational interactive television system viable in the rural Northeastern United States.

5. INTERNAL PROJECT CONTROL

To ensure that there is adequate project schedule and cost control, Mr. R.J. Turner, with experience (and academic credentials) in both engineering and business, will provide direct administrative support to Dr. Feiner. Mr. Turner is in charge of administrative operations for PCI, and his sensing of the pulse of the firm as well as the project provides us comfortable assurance that we can bring this project within the cost and time limitations established.

6. THE PROJECT TEAM ORGANIZATION ENSURES DIVERSITY OF PERSPECTIVE & SKILLS

The perspectives of the core members of the PCI project team are shown in Figure 2, where we attempt to visually portray the fact that the key members of this project staff have skills and experience that are both complementary and sufficiently overlapping to ensure effective communication and their ability to work as a unified team. It is of more than salutory interest to note that the key decision makers within the project itself are Dr. Feiner and Dr. Popper, to whom two of the PCI principals - Mr. Rosenberg and Dr. Posner - are clearly subordinate.

This provides another form of check and balance to ensure that the orientation of the team is continually toward NIE's real needs.

We have added in the core team, shown in Figure 2, Mr. Charles Blaschke, of Education Turnkey Systems ("Turnkey"). Mr. Blaschke will be responsible for the retrospective analysis discussed later, and for Mr. Jack Sweeney's operations in cost model development, based upon his insight into the organizational issues facing NIE, specific issues faced by the local schools, and his extensive experience in dealing with local school problems. (It is to Mr. Blaschke and his Turnkey operations, that we are indebted for our preliminary data regarding the effects of what we have called "management" changes in the local schools.) In a sense, then, PCI has developed a manageable consortium to ensure that the necessary diversity of viewpoints are brought to bear on this evaluation. The key members of that consortium are:

1. Dr. George Gerbner, Dean of the Annenberg School of Communications, University of Pennsylvannia, who will be responsible for the technical aspects of our content analyses;

2. Mr. Charles Blaschke, President of Educational Turnkey Systems, and having great insight into both the federal and the local school perspectives involved in education;

3. Mr. Bernie Miller of ECON, Incorporated, providing individual and corporate expertise in forecasting the economic impact of various modes of satellite communication utilization.

In these three cases, we are of course dealing with organizations as well as individuals, but based on personal confidence in the individuals. Thus, although Dr. George Gerbner himself is clearly the key to our approach to content analysis, we have proved to ourselves that the organization he represents is fully adequate to meet our needs over the medium and long-term. We have made a careful tradeoff for example, between the superior analytic pre-computer processing capabilities of Dr. Gerbner and those of such alternative sources as Cambridge Computer Associates, and decided that in balance the technical problem to be addressed in our study is much more one of coding and analytical techniques than it is of computer operations. Hence, our choice of Dr. Gerbner, in lieu of the alternatives that one would consider as having greater skills in the computer operations per se.

Our choice of Educational Turnkey Systems, Mr. Charles Blaschke as their key representative is based on a personal knowledge of his skills over the last six years. We know of no other firm that can offer comparable insight into organizational dynamics and the local school systems as Mr. Blaschke and his firm, Education Turnkey Systems. Hence, Mr. Blaschke will be intimately involved throughout the course of the study - in a manner that takes full advantage of his personal expertise and of the expertise of his firm.

In a similar fashion, PCI's involvement with ECON - a firm of technologists and economists concerned with the 'larger' issues of satellite communications and capabilities, is based upon our personal knowledge of the capabilities of Mr. Bernard Miller, who will represent that firm in their dealings with us. He and his firm will provide access to the best thinking of the satellite technologists in terms of the technology per se and the cost implications.

Our subcontract with them will take advantage of the fact that this is a young firm eager to show itself before NIE and other federal audiences. We expect the additional motivation offered by ECON's interest in demonstrating the quality of its product to NIE audiences, as an important motivating factor to produce a highly cost effective return on our investment in this subcontract.

7. FURTHER DISCUSSION OF INTERNAL TASK MANAGEMENT

To further clarify our approach to the management of the recommended project activities, we here discuss the individual subelements of the four key management functions:

1. Measurement and analysis (R. Popper, PhD.);
2. Regional evaluation support (M. Hageboeck);
3. Economic and cost analyses (L.D. Posner, PhD);
4. NIE's R & D Policy (L.J.Rosenberg).

Biographies of the staff shown in Figure 1 are included at the end of this section, followed by biographies of staff proposed and available for this engagement on an as-required basis.

1. Measurement Analysis

This overall task is the responsibility of Dr. Roger Popper, who has borne the major technical burden of our Phase II design effort.

a. Questionnaire Development and Validation

The questionnaires will be developed and validated under the personal supervision of Dr. Popper to ensure that the questions effectively address the issues of importance and are appropriately interrelated with the other branches of our analytical effort - particularly content and linguistic analysis.

b. Linguistic Analysis

Linguistic analysis, which we are proposing as a substitute for questionnaires in Alaska, will be carried out by Roger Popper with the help of a social scientist yet to be identified who is familiar with Alaskan native cultures and languages. It is probable that he will be associated with the University of Alaska.

c. Content Analysis

This activity will be subcontracted to Dr. George Gerbner, Dean of the Annenberg School of Communications, University of Pennsylvannia, under the close supervision of Dr. Popper. (Dr. Popper will spend approximately 30% of his time during the first year on this content and linguistic analysis activity.) Dr. Gerbner's credentials in this activity are illustrated by his article in the September 1972 issue of Scientific American entitled

Communication and Social Environment, and a book of which he is co-author: Analysis of Communication Content.

d. Survey Samples and Techniques

To ensure that this important task is given proper emphasis, we are assigning it as a specific responsibility to Dr. Paul Roberts, and economist and econometrician with extensive theoritical as well as practical experience in statistical analysis and research design.

2. Regional Evaluation Support

The regional evaluation support functions will be the responsibility of Ms. Molly Hageboeck, an experienced manager of evaluation studies, who will be phasing out of her activities managing PCI's support of the "Interact" television network (linking the University of Vermont, Dartmouth, and five regional medical institutions to provide an integrated health education capability via interactive television).

a. Computer Operations

Computer operations and logistics will be the responsibility of Mr. Thomas Amenta, a skilled computer analyst who is currently working with Ms. Hageboeck on processing of the market study data for her interactive television network. Mr. Amenta has previously worked closely with PCI staff on a variety of their functions while he (Mr. Amenta) managed ITT's Washington computer operations. During the experiment year, the computer operations activity will debug operating routines for use during the post experiment year. That programming activity will utilize a remote access terminal for flexibility and convenience, but actual (year 2) data will be batch processed for economy. Where model development requires special skills, Mr. Amenta will be supported by Messrs. Paul Rassam and Lawton. Mr. Rassam's extensive experience in development of transportation models will be of value in modeling costs of various conventional alternatives as well as satellite links. Mr. Lawton's experience with telecommunications technology, as well as operations research, will provide similar support where the technology itself is the pacing issue.

b. On-Site Support of the Evaluation Functions

The team supporting the regional evaluation activities has been chosen both on its proven ability to work with local evaluation staff and an ability to provide assistance in a low-key non-directive fashion.

In Appalachia, this function will be discharged by Mr. Terry Schmidt, a skilled evaluator, manager and organizational analyst. Mr. Schmidt has worked with diverse communities (most recently, providing management assistance to working-level managers in the Government of Bangladesh), and is well suited to providing direct assistance, while obtaining local cooperation with the aims of our national-level study.

The support for the Alaska regional evaluation function will be provided directly by Dr. Popper, because of his interest in the Alaska experiment (in terms of sociological impact, etc.).

Support to the Rocky Mountain evaluation function will be provided by Mr. Roger Coates, who has worked with a variety of local action groups, and who has continued his role of providing management and evaluation support to high technology activities in such rural areas as the Interact TV Project in Vermont/New Hampshire and the Government of Bangladesh. Mr. Coates was also a participant in PCI's study of U.S. private sector investments and technology, thus equipping him with additional insight into some of the technological decisions.

c. Library Functions and Development of Baseline Data
This function, because of its long-term importance, has been particularized and will be the responsibility of Mr. Joel Schlesinger, who performed this function during the Phase II study.

3. Economic and Cost Analysis

The overall economic and cost analysis activity will be headed by Dr. Lawrence Posner, who directed the cost analysis study during our Phase II design efforts. He will be closely supported by Ms. Molly Hageboeck in the actual performance of the demand analysis, based on her related experience in performing market studies of the determined pricing strategies for the Interactive Television Network in rural New England. (Thus, Ms. Hageboeck will provide a bridge between the economic analyses performed by Dr. Posner and the questionnaire activities performed by Dr. Popper.)

a. Cost Model
The development of a cost model, with emphasis on understanding the real costs to schools (in terms of opportunity costs as well as investments), will be performed by Mr. Jack Sweeney of Educational Turnkey Systems, under Dr. Posner's supervision. Mr. Sweeney, and Turnkey generally, have had extensive experience performing comparable cost analyses in local school systems as reflected in their development and application of the COST-ED model - a unique analysis tool utilized in many local school districts throughout the country.

b. Engineering and Technology

Technological and engineering cost support - in terms of analyzing and predicting cost of alternative technology, as well as assessment of the engineering quality of the ESCD experiment in terms such that we can postulate lower cost systems that do not degrade effective performance, will be the direct responsibility of Mr. Bernard P. Miller, of ECON, Incorporated. Mr. Miller is an old hand in the satellite business, and has borne major management responsibilities for a variety of spacecraft and satellite programs (e.g., while a program manager at RCA's astro-electronics division). He is the director of Systems Analysis Design for ECON, Incorporated, a firm specializing in the cost and economic analyses of satellite communications.

c. Impact on Secondary Investment

Analysis of the secondary investments made based upon the ESCD demonstration, and an extrapolation of those investments to predict the impact of subsequent federal investments, will be personally directed by Dr. Posner. He will perform this activity based on his knowledge not only of this project, but on prior activities to analyze the nature of and reasons for industrial investment and technological innovation. He will be supported in this activity by Messrs. Miller, Rosenberg and Feiner.

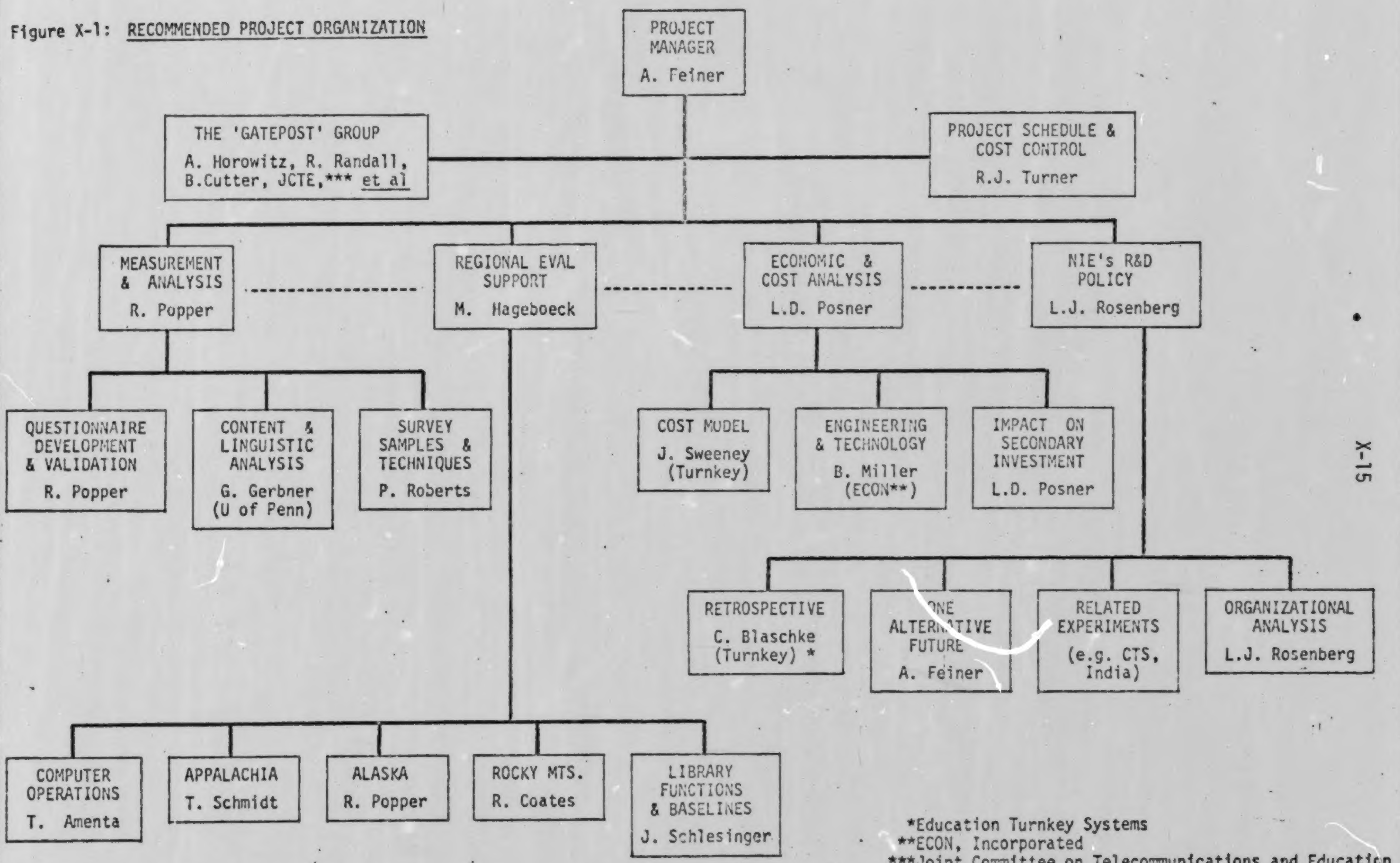
4. NIE's Research and Development Policy

There are a series of research and development policy issues involving the various interfaces between the community affected by this demonstration, that deserve special attention. We are giving it that special attention by making it the personal responsibility of Mr. L.J. Rosenberg, PCI's chief executive and a student of R & D impact. He will work closely in this function with Mr. Charles Blaschke, Mr. Albert Feiner, and various members of our "gatepost" group.

The retrospective study - an analysis of the events and documentation that resulted in the ESCD experiment - will be performed by Mr. Charles Blaschke of Educational Turnkey Systems, based upon his personal awareness of many of the individuals and issues involved. This retrospective study will use as a starting point the data already developed by NIE for its own "history of the project," and will attempt to flesh out that history so that we can define the instant in time at which the ESCD became a concept, the forces involved in development of that concept, the point at which that concept became an operational reality, and the factors and forces involved. This study should provide great insight into the proper relationship between NIE and other decision makers in setting up and performing such demonstrations.

The examination of "one alternative future" - the future by which satellite communications is the coalescing technology for dramatic change in education - will be personally directed by Dr. Albert Feiner, based upon his extensive knowledge of the various technologies involved and particularly upon his extensive knowledge of the best case utilization in such other sectors as health.

Figure X-1: RECOMMENDED PROJECT ORGANIZATION


PROJECT MANAGER
A. Feiner
THE 'GATEPOST' GROUP
A. Horowitz, R. Randall, B.Cutter, JCTE,*** et al
PROJECT SCHEDULE & COST CONTROL
R.J. Turner
MEASUREMENT & ANALYSIS
R. Popper
REGIONAL EVAL SUPPORT
M. Hageboeck
ECONOMIC & COST ANALYSIS
L.D. Posner
NIE's R&D POLICY
L.J. Rosenberg
QUESTIONNAIRE DEVELOPMENT & VALIDATION
R. Popper
CONTENT & LINGUISTIC ANALYSIS
G. Gerbner (U of Penn)
SURVEY SAMPLES & TECHNIQUES
P. Roberts
COST MODEL
J. Sweeney (Turnkey)
ENGINEERING & TECHNOLOGY
B. Miller (ECON**)
IMPACT ON SECONDARY INVESTMENT
L.D. Posner
RETROSPECTIVE
C. Blaschke (Turnkey) *
ONE ALTERNATIVE FUTURE
A. Feiner
RELATED EXPERIMENTS
(e.g. CTS, India)
ORGANIZATIONAL ANALYSIS
L.J. Rosenberg
COMPUTER OPERATIONS
T. Amenta
APPALACHIA
T. Schmidt
ALASKA
R. Popper
ROCKY MTS.
R. Coates
LIBRARY FUNCTIONS & BASELINES
J. Schlesinger

*Education Turnkey Systems
**ECON, Incorporated
***Joint Committee on Telecommunications and Education

NAME:	Leon J. Rosenberg
KEY SKILLS AND EXPERIENCE:	Evaluation, Management systems, research management, information systems.
EXPERIENCE SYNOPSIS:	Mr. Rosenberg pioneered the development of the evaluation and project/program design concepts and systems now used by PCI and extensively applied in the Federal community. He has evaluated socio-economic development projects in [illegible]1 countries (including a number of health projects). Mr. Rosenberg has been active in developing non-reactive interviewing approaches to both organizational reviews and for general application in large-scale data gathering regimes, most recently applied to PCI's evaluation of higher education.

Mr. Rosenberg is currently directing PCI's analysis of interactive TV as an educational medium (for NIH -- National Library of Medicine) and is principal investigator on an NSF study of monitoring U.S. investment in technological innovation. He was instrumental in developing approaches to, and analyzing data for, PCI's evaluation of African Scholarship and Fellowship programs.

Mr. Rosenberg is also directing PCI's work in evaluation of:

- health research aimed at vaccine development;
- organizational viability of health and family planning institutions.

As a principal of Fry Consultants Incorporated, Mr. Rosenberg directed studies of project evaluation and management, which resulted in a system to improve evaluation and planning. He also worked with local Concentrated Employment Program managers to develop decision/information models appropriate to their management needs, and to relate Federal efforts to the local (small business, small farm) economy.

As a manager in the Peat, Marwick, Livingston Federal practice, Mr. Rosenberg directed a number of major efforts, including a study to establish a government-wide R&D reporting capability. This study, performed for the Office of Science and Technology of the Executive Office of the President, analyzed R&D management practice and R&D information systems for all departments of government.

Earlier experience includes: managing consulting efforts for major technology programs; development of technical information systems; and engineering management for a major aerospace firm. Engineering experience includes earth-satellite systems engineering, logistics support, and development/verification of electronic systems. He was also active in electronic medicine, including development of devices for use in open heart surgery.

Mr. Rosenberg received his SB degree in physics from the University of Chicago and his AB degree from the College of the University of Chicago. He has authored numerous papers on such diverse topics as contract administration, effects of nuclear radiation, prepackaging of information to meet user needs, local action, and research evaluation.

As a manager in the Peat, Marwick, Livingston Federal practice, Mr. Rosenberg directed a number of major efforts, including a study to establish a government-wide R&D reporting capability. This study, performed for the Office of Science and Technology of the Executive Office of the President, analyzed R&D management practice and R&D information systems for all departments of government.

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Mr. Rosenberg received his SB degree in physics from the University of Chicago and his AB degree from the College of the University of Chicago. He has authored numerous papers on such diverse topics as contract administration, effects of nuclear radiation, and pre-packaging of information to meet user needs.

NAME: Albert Feiner

KEY SKILLS AND EXPERIENCE: Biomedical Communications, Health education, Research, Project Management

EXPERIENCE SYNOPSIS: Dr. Feiner's extensive experience in developing and executing scientific, engineering and technical research and development programs in biomedical communications will provide key impetus and direction for strengthening and further developing PCI's health practice.

Dr. Feiner was formerly Director at the Lister Hill National Center for Biomedical Communications at the National Library of Medicine. There he was involved in a number of significant programs: (1) An Experimental Medical Satellite Communications Network which involved more than 20 villages in Alaska whose only contact with a physician was via the satellite. Protocol, remote patient management and consumer education were all part of this investigation. (2) Cable Television for Consumer Health Education which involved education of our elderly population in their own health management. One-way and two-way interactions were explored. (3) On-line Computer Network which was a national metwork designed to foster sharing of educational materials between medical institutions. (4) Microwave Interactive Television Network which explored a new concept in rural health care delivery and education whereby two medical centers provide consultation and educational experiences for health professionals and laymen isolated by geography and climate. This network represents the only switched television network in existence.

Dr. Feiner has previously worked as Manager at Magnavox Research Laboratories developing a business and financial plan leading to the establishment of a new organization to pursue opportunities in the developing field of cable and closed circuit television.

Dr. Feiner has also worked as Manager in Satellite Communication Earth Stations at Hughes Aircraft Company. In this capacity he was given the responsibility to define the Hughes Aircraft Company's role in the developing commercial satellite communication earth station market. This responsibility included the definition of the earth station configuration, identification of developments required to give Hughes a competitive advantage and determination of the market "entry fee."

During this period, in conjunction with several departmental personnel, the STAR (Satellite Telecommunications with Automatic Routing) concept was evolved. The purpose of STAR was to provide satellite access to a number of small user nations on a demand-assignment basis so that a relatively small number of channels could handle a large number of users whose requirements were sporadic and of limited duration. STAR was the forerunner of COMSAT Corporation's multiple access system.

Prior to this activity, Dr. Feiner was Hughes' chief engineer on the definition study of the Transportable Satellite Communication Link Terminal which became part of the DCS network as the AN/MSC-46.

Dr. Feiner has also work as Chief of Advanced Development Laboratory, Directorate of Communications, Rome Air Development Center, Rome, New York. While there he was responsible for the planning, justification and management of all laboratory activities which included both basic and applied research required to fully utilize satellites for global communications.

Dr. Feiner received his Bachelor of Electrical Engineering from the College of the City of New York

PUBLICATIONS: (see attached list)

PUBLICATIONS:

Solid Delay Line Development for Ground Radar Equipments

MTI Stability Problems

Optimizing the MTI Velocity Response

Three-dimensional MTI Coverage Diagram

The Effects of Low Noise Techniques on Trosposperic Scatter

Analysis of Selected Subjects for Integrated Communications and Navigation Plan for the Air Force - Until 1980 and Beyond

Analysis of Fixed and Mobile Terminal Parameters for Passive Satellite Application and Proposed Experimental Verification

RADC Passive Satellite Communications Research Terminal

Synchronous Satellites - The Key to Peaceful Uses of Outer Space

Invited by Joint Chiefs of Staff to write selected portions of "Advanced Airborne Command Post Communications" and "Command and Control of Strike Forces"

An Experimental Satellite Medical Network for Scarcity Areas

NAME: Roger D. Popper

KEY SKILLS AND EXPERIENCE: Social and Behavioral Sciences; Design and management of systematic data collection and analysis; project management; evaluation.

EXPERIENCE SYNOPSIS: Dr. Popper is currently developing instruments, measurement approaches, and analytical techniques for nation-wide application in the three ATS-F educational regions -- Appalachia, the Rocky Mountains, and Alaska. The data gathering approach makes maximum use of pre-existing data, plus direct observations and attitude surveys aimed at assessing impact of such educational programs on institutions as well as on individuals.

As a research analyst and program evaluator with the Peace Corps, Dr. Popper was responsible for conducting such activities as: transforming Volunteer Questionnaire into percentile-based, world-wide, project monitoring system, while cutting the operation's cost; he designed and contracted U.S. opinion research which was going to cost $200,000 for only $28,000; all phases of contract management, such as keeping contractors on target and heading-off cost over-runs; continual explanation of research implications to managers.

Dr. Popper's earlier experience includes directing a team doing ground-work for career guidance instruments. His team collected systematic interest-preference data from thousands of high-school students all over Chile. His instructions on data collection, item analysis, scale construction, and variability attribution were published, along with the results of the study, in book form by the sponsors of the study, the Universidad Catolica de Chile, where Dr. Popper was a researcher; he also was a University Professor at the Universidad Austral de Chile. Dr. Popper was a teaching and research assistant in perception and research design at the University of California.

Dr. Popper received his Ph.D. in Experimental Psychology from the University of California, Los Angeles, and his B.A. in the same subject from the University of California at Berkeley. He speaks three languages and has published several research papers.

NAME: Tom Amenta

KEY SKILLS AND EXPERIENCE: Design and development of computer systems; programming and data processing

EXPERIENCE SYNOPSIS: Mr. Amenta is currently responsible for the automatic data processing for PCI's survey of market value and potential prices for television-linked medical education and health services in the rural Northeast. He is developing batch edit and analysis routines.

Mr. Amenta has worked as Technical Director for Koba Associates, Inc., Datamatix Division, where he supervised a staff of professional systems analysts and programmers. He was also responsible for development and implementation of the marketing strategy of the data processing division.

He worked at the HEW Office for Civil Rights as Technical Director of a pilot HEW program to automate monitoring of contractor compliance in the construction industry in the hiring of minority employees. He was responsible for the design and operation of the system, which involved reporting forms design, reporting system design, mathematical modeling of compliance indicators, file structure design, on-line file construction, data file maintenance and output design.

Prior to that Mr. Amenta was District Manager for International Telephone and Telegraph's Data Services Division. He directed a staff of up to 10 professionals in IBM 360/65 time sharing and remote job entry services using MVT HASP. This network supported 300 simultaneous users on-line to the central Paramus installation.

Mr. Amenta has also worked as a consultant for the Central Charge Service of ITT . During this time he designed, built, and implemented credit purchase authorization system including positive accounts control, fraud detection, and accounts maintenance. This was on a real time, on-line system. Credit purchases were entered into the system by merchants at the purchase sites. Unlikely, fraudulent or overextending purchases were immediately detected for 700,000 card holders and appropriate action taken. Over $1,000,000 in fraud and bad debts was eliminated by installation of this system.

Prior to that Mr. Amenta worked at the National Urban League of ITT, where he designed and built a job bank referral and placement system that matched job requirements with personal capabilities to provide applicants with job oportunities which best fit their education, training and personal interests. All transactions were conducted on-line to a central data bank which thirty cities could use simultaneously.

Mr. Amenta has also worked as a Consultant for ITT and designed a securities portfolio management and control system for Mersereau Meek, Inc., investment brokers.

Mr. Amenta worked as a Consultant for the Planning Research Corporation prior to that where he was involved with Airport simulation design which simulated landings, departures, repairs, and refueling to determine congestion and airport capacity. This simulation was used by the Departments of Defense and Transportation to determine schedules of aircraft and support activities such as refueling schedules and repair crew schedules.

While a member of the Planning Research Corporation technical staff working with an Israeli water engineer, designed and built a simulation of the operations of various nuclear desalination plants. The model considered degradation due to corrosion and pump failures, amortization of expenses and other engineering considerations.

Prior to that Mr. Amenta worked as a Consultant to the Joint Chiefs of Staff - Mitre. He designed and evaluated logistical supply systems for world-wide defense in the event of anticipated contingencies. He designed data reporting system, retrieval system and information presentation. This system was designed to provide the Joint Chiefs of Staff with the necessary information to maximize U. S. response in limited war by pre-positioning supplies, planning shipping schedules and other logistical means.

Mr. Amenta received his B.A. from Yale University.

CHARLES BLASCHKE

President

EDUCATION:

Masters of Public Administration, Harvard University, 1965
JFK School of Government, Administrative Fellow for two years
Bachelor of Arts (Economics), Texas A & M University, 1963
Graduated with highest honors (top three in class of 700)

RELATED JOB EXPERIENCE:

1968 - Present: President and Chairman of the Board of Education Turnkey Systems, Inc. Served as Principal Investigator of the OEO Performance Contract Project, the largest Federal experiment in public education. Firm also developed and planned over 100 projects in 20 states involving unique management innovations in education.

1968-69: Manager and "Consultant", Education Programs, Insititute for Politics and Planning; managed program development of Texarkana, U.S.A. Dropout Prevention Program. Assisted in program planning and development.

1966-68: U. S. Army, assigned to the Office of the Secretary of Defense; conducted the first large-scale study on DOD use and management of new education technology, including computer-assisted instruction; served as Vice-Chairman of the first Engineering Systems for Education and Training Conference for industry and as Project Officer of Project ARISTOTLE, a 200 man-year follow-up on new developments in the education industry; responsible for establishing the first DOD-wide seminar on computer-assisted instruction.

1966-67: Instructor at Catholic University of America; created and conducted graduate seminar on "Political Economy and Education Technology".

1964-66: Consultant to the Office of the Secretary of Defense on the problems and potential of defense industry diversification into non-defense public service markets.

1965: Acting Chief for Education Technology, Community Action Program, Office of Economic Opportunity; evaluated and funded demonstration programs using compter-assisted instructional technology and assisted in developing an internal management system for CAP/OEO research, development, and demonstration projects.

1964-65: Presidential Commission on Economic Impact of Defense and Disarmament.

RELATED EDUCATIONAL ACTIVITIES:

Class President for two years, Texas A & M University
Outstanding Cadet for two years
Cadet Corps Sergeant-Major and Corps Adjutant
University nominee for Rhodes Scholarship and Fulbright Fellowship
President, Economics Club
President, Phi Eta Sigma, Phi Kappa Phi
Who's Who in American Colleges and Universities
State Vice-President, Texas FFA Association
Who's Who in the Southwest

MAJOR PUBLICATIONS:

Performance Contracting: Who Profits Most, (Phi Delta Kappan, 1972)

"Performance Contracts", Planned Change in Education: A Systems Approach, David Bushnell, Harcourt, Brace & Javanovitch, 1971.

"The COST-ED Model, A New Economic Tool Used for Negotiations", Journal of Collective Negotiations, May, 1972.

Project: Use of Incentives, U. S. Office of Education, July, 1972

"Performance Contracting, Management Reform, and J. Q. Citizen", Phi Delta Kappan, December, 1972.

Report on Performance Contract Project, Office of Economic Opportunity, August, 1971.

Nation's Schools, Monthly column on performance contracting and accountability, September, 1971 - present.

"Educational Engineering: Environmental and Institution Change to Increase Educational Productivity", a report to the Commissioner of Education, December 17, 1969. The report was presented to the White House by Associate Commissioner Leon Lessinger and in subsequent Presidential and other high level Administration speeches, reports, and books was referenced or noted as the first attempt to combine the concepts of performance contracting grants managements, education auditing, and risk capital into a cohesive policy presentation (with Peter Briggs and Reed Martin).

"Contracting for Educational Reform", Phi Delta Kappan, March, 1971 (with Reed Martin).

Performance Contracting in Education, Research Press, Champaign, Illinois, 1970; a booklet on the subject (with Peter Briggs and Reed Martin).

"The Turnkey Approach: A Leverage for School System Reform", Education Technology, September, 1970 (with Peter Briggs and Reed Martin).

"Management, Public Policy and Innovation", Education Technology, May, 1969.

"Politics, School Management and Innovation", Education Technology, May, 1969.

"Education Technology: A New Perspective", Education Technology, January, 1968.

"The DOD: A Catalyst in the Future of Education Technology", Phi Delta Kappan, January, 1967.

Report of the Subcommittee on Possibilities and Policies for Industrial Conversion, A Report for the President, August, 1964.

"CTEP #4" - A report to the Office of the Secretary of Defense, December, 1967. Results of a 200 man-year evaluation of 18 types of education technology used in the DOD $4 billion education and training program.

"CAI: Guidelines and Public Policies", a report to the U. S. Office of Education, 1968; the first cost-effective analysis of CAI and other capital intensive in education (with Ronald Randall).

A Report to the Office of the Secretary of Defense of Computer Assisted Instruction, December, 1967.

"New Developments in Education Technology", Project ARISTOTLE Proceedings, January, 1968, NSIA.

"Federal Procurement Policies: An Instrument to Increase the Rate of Innovation", a thesis prepared for MPA requirements at J.F.K. School of Government, Harvard University, 1965, which discussed the concept of performance contracting in education for the first time.

SELECTED SPEECHES ON PERFORMANCE CONTRACTING TURNKEY OPERATIONS, EDUCATION MANAGEMENT AND COST-EFFECTIVENESS AND EDUCATION TECHNOLOGY:

NEA Policy Studies Group, 1971; U. S. Chamber of Commerce Annual Convention, 1971-72; AASA Annual Conference, St. Louis, April, 1971; National School Board Conferences, February-March, 1971 in Atlanta, San Francisco, New York, Denver, and Chicago; School Board Association Annual Conference, Minneapolis, January, 1971, and Schoolmans' Day, December, 1970; Northern California: Industrial Education Council, San Francisco, January, 1971, and Dallas, November, 1970; NEA CTA Policy Group, Washington, D. C., November, 1970; Keynote Adress, National Conference of Performance Contracting, Washington, D. C., November 1970; Michigan School Board Annual Conference, Grand Rapids, December, 1970; State Department of Education Conference on Compensatory Education, Grand Rapids, Michigan, May, 1971; ARISTOTLE Conference, December, 1967, Washington, D. C.; White House Conference on Youth and Children, Morgantown, West Virginia, November, 1968; American Academy of Arts and Sciences, 1968; National Chamber of Commerce Hour, November, 1970;

Southeast Educational Television, December, 1970; National Committee for Support of Public Schools, April, 1970; AASA Annual Conventions 1971 - 72 - 73, (7 appearances).

CHRONOLOGICAL LIST OF MAJOR ACCOMPLISHMENTS:

1968 - Present: President of ETS, Inc., Principal Investigator of USOE-OEO Major Experiment in Performance Contracting; designed Dade County Incentive Project; Director of Michigan Accountability State Model technical assistance efforts; managed development of the unique COST-ED Model used in 23 states.

January, 1968 - March, 1968: Conducted, with an associate, one of the first cost-effectiveness studies of CAI feasible applications in public education; developed the COST-ED Model for determining cost justification, suggested guidelines for Federal support and evaluation; outlined existing deficiencies in USOE policies in this area (see June, 1968 issue of Education Technology for a summary of this study). Report available from USOE.

January, 1966 - December, 1967: Conducted initial task force study and evaluation of the application of educational technology in U. S. Department of Defense education and training program; this included a special report on CAI and policy recommendations. (Report has not been released to the public.) As a result of the study and of related initiatives, a centralized office for A-V activities was created with additional line item advanced development funding.

Conceived and developed program, and brought to fruition the first conference between government and education technology industry (Engineering Systems for Education and Training Conference, June, 1966). This conference laid the foundation for industry support for Project 100,000 and TRANSITION.

Served as representative and Project Manager for Office of Secretary of Defense on Project ARISTOTLE. This conference was attended by 3,000 representatives.

Assisted in securing initial funding (and ensured continued five-year funding) of a $23 million CAI-CMI project, the largest of its kind ever funded by DOD.

Designed and conducted first DOD-wide Seminar of CAI, December, 1967. Guidelines were developed and implemented as a result.

Provided position paper for and assisted in drafting speeches by Defense Department officials on the role of the Pentagon in social progress. Rationale is explained in Phi Delta Kappan, January, 1967. (See McNamara Montreal Speech, May, 1966; VFW Speech, August, 1966, announcing the creation of Project 100,000; and Clifford NSIA Speech, September, 1968).

May, 1966 - June, 1967: Created and conducted graduate seminar on the "Political Economy of Education" at Catholic University. Presently being drafted as book entitled, The Quiet Revolution.

September, 1965 - January, 1966: While at OEO, funded the first large CAI experimental programs in operational classrooms --- Chicago and Bronx ERE projects. Results of cost-effectiveness of the cluster of projects are available at CAP/OEO.

Summer, 1964 - 1965: Intern and consultant; drafted report on the potential applications of systems management and advanced technology to non-defense public service markets. Report (August, 1964) recommended that defense-oriented firms run Job Corps and OEO education and training projects. All subcommittee members except the chairman wrote dissenting reports. Concurrent with the study, initial steps were taken to establish a line item for advanced development in education, housing, and health services based on the concept of using Federal procurement to encourage innovation --- the topic of a graduate paper written while at Harvard.

NAME: Roger D. Coates

KEY SKILLS AND EXPERIENCE: Project Management and systems, development economics and programming, evaluation.

EXPERIENCE SYNOPSIS: Mr. Coates is a key figure in PCI's activities to extend program and project management concepts to development institutions with special emphasis on the firm's work with small business and in the agricultural sector. He is currently developing methods for assessing financial viability of health delivery and family planning organizations.

He is also participating in an analysis of the needs of LDC Planning Commission for a management-oriented project design and evaluation system.

Mr. Coates has counseled numerous domestic development organizations in the techniques of project development and management. He has been particularly active in the assessment of development project and business venture ideas for both economic feasibility and program suitability. Such work has encompassed the preparation of feasibility analyses, the development of organizational management plans, and the creation of capital structures for business ventures and service activities in several industries and development sectors. As the director of a nation-wide program and project team to provide such assistance to community development corporations, Mr. Coates directed the management assistance efforts of persons with a wide variety of professional skills and trained CDC management in the effective utilization of such outside expertise. He has been instrumental in the development of approaches to management and technical assistance which emphasize management capacity of the organizations being assisted.

Mr. Coates has also evaluated several public programs, most notably ones concerned with economic development, and has participated in the use of these assessments in continuing program development and organizational improvement.

As an Assistant Director of Boise Cascade's Center for Community Development, Mr. Coates directed studies of business enterprises especially suited to specific geographical locations participated in an evaluation of the impact of Federal programs on Indian reservations, and directed a amangement assistance program for the grantees of OEO's special impact program.

Earlier experience includes the development of a nation-wide program information system for the Department of Commerce and the development of output measures for a comprehensive community development program for the Office of Economic Opportunity.

Mr. Coates received his AB degree in International Relations from Dartmouth College and his MBA degree from Stanford University where he was an international study fellow.

NAME: Molly Hageboeck

KEY SKILLS AND EXPERIENCE: Economic Development, Evaluation, Training.

EXPERIENCE SYNOPSIS: Ms. Hageboeck is a PCI staff member who has a heavy emphasis on evaluation and training. She recently managed a PCI evaluation for the National Library of Medicine which assessed the impact of health education services provided by the New Hampshire/Vermont Interactive Television Network. Ms. Hageboeck is currently managing a second engagement with the National Library of Medicine which will test whether the health service television network can become self-supporting. The major components of this engagement will include market analysis and management assistance to the interactive television network.

As a PCI consultant, Ms. Hageboeck managed PCI's evaluation of AID-sponsored African scholarship programs, involving field work in eight African countries and surveys/analyses involving 28 African nations. Ms. Hageboeck refined PCI's training course in evaluation/planning for subsequent administration to development managers in both the U.S. (e.g., OEO and AID) and Less Developed Countries (e.g., Brazil and the Philippines).

Ms. Hageboeck's prior experience in evaluation and training was as an officer of AID. On specific assignment from the AID Director of Evaluation, she developed a training manual (describing the Project Evaluation System developed by PCI) for field evaluation officers.

Ms. Hageboeck's further assignments with PCI have included training AID and host government personnel in project design approaches, an organizational/functional review of centrally-funded technical assistance grants and contracts, review of evaluation mechanisms in USAID/Vietnam, and participation in a PCI team providing program management assistance to host personnel in South America.

Prior to her experience with AID, Ms. Hageboeck was part of Peace Corps Washington staff, and subsequently on assignment to Bangkok and Manila. In Bangkok, Ms. Hageboeck worked as a consultant on a feasibility study of a mathematics teacher training program for the Thai Ministry of Education. In Manila she coordinated a Conference on

Evaluation of National Mathematics Teacher Training Program, Bureau of Public Schools and Peace Corps. She also supervised the application of modern teaching techniques for math and science in the Philippine Elementary school system, directed mathematics teacher training programs, and developed teacher training in modern training curriculum for math and science in the province of Laguna, Philippines.

Ms. Hageboeck received her MPA (specialization: Economic Development) from the Woodrow Wilson School of Public and International Affairs, Princeton University. While at the Woodrow Wilson School, Ms. Hageboeck undertook extensive research on the diffusion of technological and production innovations at the villages level in the developing nations. She has a B.A. in East Asian History from the Connecticut College for Women. Ms. Hageboeck also carried a full major in experimental and social psychology.

Ms. Hageboeck is currently serving as a member of the National Academy of Sciences Advisory Committee to the Peace Corps on "New Directions for the Peace Corps."

NAME: Bernard P. Miller

KEY SKILLS AND EXPERIENCE: R&D and engineering management; TV systems; high technology applications for development.

EXPERIENCE SYNOPSIS: Mr. Miller has most recently been providing consulting services in use of satellite and other high-technology systems for monitoring and control of natural resources.

Prior to association with PCI, Mr. Miller was Special Projects Manager for RCA Astro-Electronics Division -- involved in advanced systems development of earth-satellite and space-shuttle payloads.

In 1967 Mr. Miller was appointed Manager of the RCA Earth Resources Satellite Program, and in 1969 was appointed Manager, Earth Resources Multispectral Camera System. The Earth Resources Multispectral Camera System involved the development and production of a 4500 line TV camera, and the development and fabrication of video processing and display equipment for this camera system. This camera system will be used to obtain high-resolution multi-spectral photographs of the earth for resource planning and management. In addition to the development of the ultra-high resolution TV camera, other unique features in this program included the development of computer controlled equipment for the testing of the cameras, and the development of electron beam on film and laser beam on film recording equipment to display the camera output. In addition to basic contracts with NASA for the design, development, and production of the camera system, the RCA Earth Resources Program included separate contracts with Bendix, GE, and the Canadian government for the development and production of video display and recording equipment. In 1971, Mr. Miller received an Industrial Research (IR-100) award for his work on the 2" Return Beam Vidicon Camera and Laser Beam Image Reproducer developed for the Earth Resources Multispectral Camera System.

Mr. Miller was Project Manager of the $28 million Ranger Project. He managed the design, fabrication, testing, and flight operations for this 380-pound, six-camera television payload of the Ranger spacecraft. Included in the Ranger Project was the design, installation, and operation of the video reception and processing equipment at the NASA facility at Goldstone, California.

Following the successful completion of the Ranger Program in 1965, Mr. Miller managed the preliminary design studies on the Voyager spacecraft for Mars exploration, and directed RCA-sponsored studies in the area of military communications satellites.

From 1950 to 1953, as a Captain in the USAF, Mr. Miller was assigned to the Aircraft Laboratory, Wright Field, with responsibility for special flight test projects. Following his work at the Air Force Institute of Technology in 1954, he taught at the U.S. Naval Academy, Annapolis, as an instructor of Fluid Dynamics and Thermodynamics. In 1956 he was appointed Head of the Thermodynamics Group of the Academy's Department of Marine Engineering. He joined the RCA Special Systems and Development Department in Princeton in 1957, and transferred to the Astro-Electronics Division in 1958. There, on Project JANUS, he performed trajectory and orbital analyses and ascertained propulsion-system requirements. From 1959 through 1961, he was Project Engineer on a series of studies examining military applications of space systems. In 1961, Mr. Miller participated in the series of studies that eventually led to the RCA Ranger Project.

Mr. Miller received a BS in Aeronautical Engineering from Pennsylvania State University in 1950, and did post-graduate work in Aeronautical Engineering at the U.S. Air Force Institute of Technology in 1953 and 1954 and at Princeton University from 1957 to 1959. He is a graduate of the Cornell University Executive Development Program.

Mr. Miller is an Associate Fellow of the American Institute of Aeronautics and Astronautics, and is a member of the AIAA Space Systems Technical Committee (1970-73). As a member of the Space Systems Technical Committee he has been active in the planning and implementation of projects, such as the assessment of Strategies for Exploration of the Solar System and the Space Shuttle Assessment. He has served as Chairman of the Princeton Section of the AIAA, and as Associate Editor of the Journal of Spacecraft and Rockets. Mr. Miller has published numerous papers on spacecraft systems, television, and television recording and display technology.

Mr. Miller received one of the coveted NASA Public Service awards in October 1964 for management of the RCA team that developed the six-camera television system used aboard the successful Ranger 7, 8, and 9 spacecraft to obtain the first-high-resolution photographs of the moon.

NAME: Lawrence D. Posner

KEY SKILLS AND EXPERIENCE: Evaluation, economics, social and economic development, health, education, and cost-benefit analysis.

EXPERIENCE SYNOPSIS: Dr. Posner is responsible for directing and managing PCI's health-related activities in less developed countries. Dr. Posner helped the American Public Health Association (APHA) design a low cost health delivery system for rural Thailand. He helped adapt a Thai plan for the Thailand DEIDS project to reflect AID/s priorities (low cost, replicability in other rural areas, and evaluation) and present the project using AID's programming concepts and terminology.

Dr. Posner directed an evaluation of an AID Loan to develop health centers and rural mobile health units in Nicaragua. The evaluation included 74 site visits at Health Delivery Sites as well as analysis of the supporting systems for staffing, medicines, vehicles, facilities, equipment, and supervision. Experimental evaluation approaches were developed to analyze the services received by patients. Dr. Posner is participating in PCI's study for AID to develop realistic and practical indicators of institutional viability with special emphasis on health and family planning institutions. He is also Principal Investigator in PCI's study for the National Science Foundation on the feasibility of monitoring expenditures on Technological Innovation.

Dr. Posner has had extensive experience with AID's Project Evaluation System, having been one of the original developers of the system. He has been called upon by AID to attend four Regional Evaluation Conferences as an "evaluation expert," has himself managed several project evaluations, and has worked in LDCs in Asia, Africa, and Latin America.

Dr. Posner played an instrumental role in PCI's evaluation of the African scholarship programs. He recently managed an analysis of the headquarters' activities of four organizations assisting cooperatives in developing countries.

Dr. Posner was responsible for the data processing of PCI's Africa-wide evaluation of higher education impact, and previously analyzed the basic project and performance data from which PCI developed its evaluation concepts.

In his earlier work for PCI, Dr. Posner managed PCI's engagemen for the Department of State, Agency for International Developme to improve evaluation of development assistance by systematizin the evaluation process in AID Missions throughout the world. This engagement involved PCI participation in the evaluation of at least 81 development projects, and the installation of a Mission-useful management system at each of 35 overseas locatio Dr. Posner participated in 10 Mission installations, 3 Regional Evaluation Conferences, and follow-up visits to 3 Missions.

Dr. Posner participated in PCI's assistance to the Department of Health, Education & Welfare to improve the management of its $11 million per year educational evaluations.

In 1970, Dr. Posner analyzed AID projects in India, Afghanistan Brazil, Paraguay, Ecuador, and Kenya. He also used computer techniques to assess the utility of evaluation data for analyzing development projects.

As a consultant to IBM, Dr. Posner analyzed instruction techniques for training, and developed computer models for establishing cost-effective educational programs.

Earlier experience includes Dr. Posner's analysis of varied projects in Peru, Nigeria, Spain, Cyprus, Greece, Puerto Rico, Dominican Republic, and the United States. The fields studied include development banks, cooperatives, urban water supply, airlines, copper mining, steel, food consumption, teacher training and television. He spent a year in Latin America with a travelling fellowship studying possible Peace Corps Programs.

Dr. Posner received his Ph.D. in economics from Harvard Univers Areas of concentration in his doctoral studies were the economi of underdeveloped countries and the economics of education and job training. His dissertation was an analysis of investment i job training.

Dr. Posner received his MBA degree from Harvard Business School with High Distinction. He was a Baker Scholar. His field of concentration was international economics. His BA is from Amherst College, where he wrote a thesis on Agrarian Reform in Egypt. He speaks Spanish fluently.

NAME: C. Paul Roberts

KEY SKILLS AND EXPERIENCE: Economics of health and education, project evaluation, applied management tools in private and public sector, applied research methods, forecasting, cost analysis, Latin America.

EXPERIENCE SYNOPSIS: Dr. Roberts is responsible for economic analysis of innovative health and education delivery systems. He is designing an economic analysis of the ATS-F satellite for the National Institute of Education. The satellite will broadcast education television programs to Alaska, Appalachia, and the Rocky Mountains. The analysis will define the conditions when satellites can be used to serve isolated rural areas without government subsidies. Dr. Roberts is developing PCI training modules on cost-effectiveness analysis, "soft" econometrics, and analysis of cross-sectional and longitudinal data. He is also developing an approach to auditing the social and economic impact of multi-national corporations in Latin America.

In 1973, Dr. Roberts served in Ecuador as a consultant to the American Public Health Association and UCLA. He assessed the feasibility of a proposed low-cost health delivery system for three rural provinces in 1975-80. Dr. Roberts worked with top Ministry of Health Officials and members of the Presidential National Planning Council and conducted extensive interviews with local health personnel in the rural areas. Special priority was given to include in project planning the constraints on health delivery.

Also in 1973, Dr. Roberts advised Ecuador's Ministry of Education on an AID-funded technical assistance program. He developed a method to collect data and maintain an on-going assessment of the efficiency of the Ecuadorean educational system. His recommendations included coordinating the input of health and nutritional services with primary school education as an effective means to improve the educational and health welfare of an easily accessible population.

Dr. Roberts worked for the National Institute for Mental Health as a consultant for the Ethnic Survey Program at UCLA. He developed research strategies directed at eliciting the views of minority community members on mental health problems. He selected target populations for each of the five major ethnic groups in Los Angeles County with the cooperation of local community organizations. One of the critical technical problems was to devise an instrument that would provide comparable measurements across cultural lines without jeopardizing each ethnic group's responsiveness.

Dr. Roberts' statistics work includes training twelve full-time workers in survey methods and introducing many of them to basic statistical techniques. Dr. Roberts improved census estimates of minority population by statistically adjusting 1970 census data.

Dr. Roberts developed an econometric model for a large private pre-paid health insurance plan to forecast the demand for health services. The model was used to predict health services enrollment based on local and regional economic effects on specified occupational groups after controlling fo differences in income and other demographic characteristics. Selected occupations were also identified as low-risk groups that should be targeted for penetration.

As Director of the Economic Analysis of Education Project in Costs Rica, sponsored by the Ministry of Education and the Planning Office of the University of Costa Rica and the Latin American Center at UCLA, Dr. Roberts analyzed the influences of health, family background, and other human capital compone on schooling and earnings. Dr. Roberts supervised the traini and work of six full-time survey workers during one year of data collection activities and visited virtually every population center in Costa Rica. He taught in the Economics Department of the University of Costa Rica, emphasizing the economi of health and education in his lectures. Subsequently, he lectured on research methods at UCLA in a series of inter-departmental lectures sponsored by the Latin America Center.

From 1966-69, Dr. Roberts served as editor and statistician for the Latin American Center at UCLA. He directed preparati of the annual Statistical Abstract of Latin America and collaborated in the statistical compilation and verification of articles or books on Latin America published by UCLA. Dr. Roberts supported graduate students undertaking original research in Latin America and developed a successful statistica exchange program which involved extensive contacts with gover ments throughout middle America and the Caribbean area.

The lack of adequate data on Cuba prompted an authorized UCLA sponsored trip to that island in 1968 and again in 1969. UCL and the Cuban Department of Statistics agreed to cooperate on the publication of a series of data focusing particularly on the 1950-68 period. Heretofore unpublished economic, trade. and production data were augmented with a comprehensive set o demographic, health, and education statistics. This year-lon project required working with a variety of Cuban officials, especially at the National Planning Council. In turn, it was also necessary to follow the data aggregation process and evaluate data reliability and validity at most levels of statistical compilation, by site visits and working with those involved. An important by-product of these visits was the understanding of new means to deliver health and educational services in developing countries.

Recently, Dr. Roberts taught research methods for public sector analysis in the School of Public Administration at the University of Southern California. At the same time, he coordinated a series of service activities extended to Arizona, California, and Nevada public sector managers (including country mental health administrators, city managers, court officials, and law enforcement officers). Most cases centered on determining cost-effective methods to implement new programs and/or revise on-going activities. In a few instances, he called for the reorganization of data collection procedures to insure feedback of useful information.

Dr. Roberts received his Ph.D. in International Economics and Management from the Graduate School of Management at UCLA. Business economics, the economics of underdevelopment, and economics of human resources were three additional areas of doctoral studies. Dr. Roberts wrote his dissertation on the economics of education in Costa Rica.

Stanford University granted Dr. Roberts an M.A. with high honors in the Economics and Politics of Latin America. His B.A. degree in English and Spanish literature is from Wheaton College.

Dr. Roberts is completely fluent in Spanish and English. He is a U.S. citizen. He was raised in Costa Rica and has lived over seventeen years in Latin America, mostly in Costa Rica and Colombia.

NAME:	Joel E. Schlesinger
KEY SKILLS AND EXPERIENCE:	Communications Skills, Rural Industrial and Agri-business, Intercultural Education and Training.
EXPERIENCE SYNOPSIS:	Mr. Schlesinger, a PCI consultant, is the documentation officer in PCI's study for the National Institute of Education to test the effectiveness of satellite technology in meeting the special needs of rural educational systems. Mr. Schlesinger's prior experience in the communications and educational fields includes work as a secondary school teacher in Senegal, West Africa, as well as consulting assignments to the Peace Corps for teacher training and curriculum development, and to Perspectives in Communication for development of programs in cross-cultural and media education. He has served as administrative officer and evaluator to both the Association of World Colleges and Universities, Huntington, New York, and the Partnership for Productivity Service Foundation, Western Province, Kenya, where he also functioned as a development specialist to rural industrial and agri-business concerns. He has represented the Foundation for Arab-Israeli Reconciliation during meetings with foreign representatives, and served as an interpreter for USIS. Mr. Schlesinger received his M.I.A. degree in International Administration from the School for International Training, Brattleboro, Vermont. His B.A. in political science is from the University of Pittsburgh. He holds a diploma in general studies from the European-American Study Center, Basel, Switzerland.
PAPERS:	Schlesinger, Joel, "Business Development in Western Keyna," presented at the School for International Training, 1973. Ben-Dak, Joseph and Schlesinger, Joel, "Some Straight Thinking About the United Nations University," presented at United Nations University Conference, Waltham, Massachusetts, 1973.

NAME: Terry D. Schmidt

KEY SKILLS AND EXPERIENCE: Evaluation, Management systems

EXPERIENCE SYNOPSIS: Mr. Schmidt plays a major role in PCI's work in the installation of project management and evaluation systems in public institutions. He is particularly skilled in the introduction and refinement of managerial performance standards within public and private organizations.

Mr. Schmidt has acquired significant experience in the assessment of organizations and programs since completing his formal education. He has directed the efforts of a sizeable project team in the evaluation of a major air traffic control program for the Office of Planning and Program Review, Department of Transportation. As Project Manager, Mr. Schmidt developed functional analysis methodology, assigned and supervised member tasks, directed staff meetings, effected liaison with concerned parties, and formally briefed higher management. The evaluation was cited for excellence in Public Administration Review.

Mr. Schmidt has also conducted assessments of various financial packages and proposals for several clients. As a consultant to the Canadian Ministry of Industry, Trade, and Commerce, he has completed an evaluation of an option to purchase a major Canadian company; duties included project scheduling and control, financial evaluation, a marketing study, field interviewing, a technology assessment, and policy analysis.

Mr. Schmidt has also prepared financial and legislative statements relative to the sale of two major U.S. airports for the Department of Transportation and has conducted a study of organizational strengths and weaknesses leading to a reorganization for a major international air carrier.

Mr. Schmidt received his BS degree in Aeronautics and Astronautics from the University of Washington, where he won an award from the American Society of Mechanical Engineers for a paper on the interaction of technology and society. He received his MBA degree from Harvard Business School where he was the senior editor of the Harvard Business School newspaper.

NAME: R. J. Turner

KEY SKILLS AND EXPERIENCE: Financial management, Business administration, project management audit, financial review and analysis, evaluation, engineering.

EXPERIENCE SYNOPSIS: Mr. R. J. Turner is currently developing an integrated management, administrative, and fiscal system for application to medium service organizations. This system develops weekly management reports based upon both manual and automated versions of the system. He is responsible for the development of internal management, administration, and financial systems for PCI.

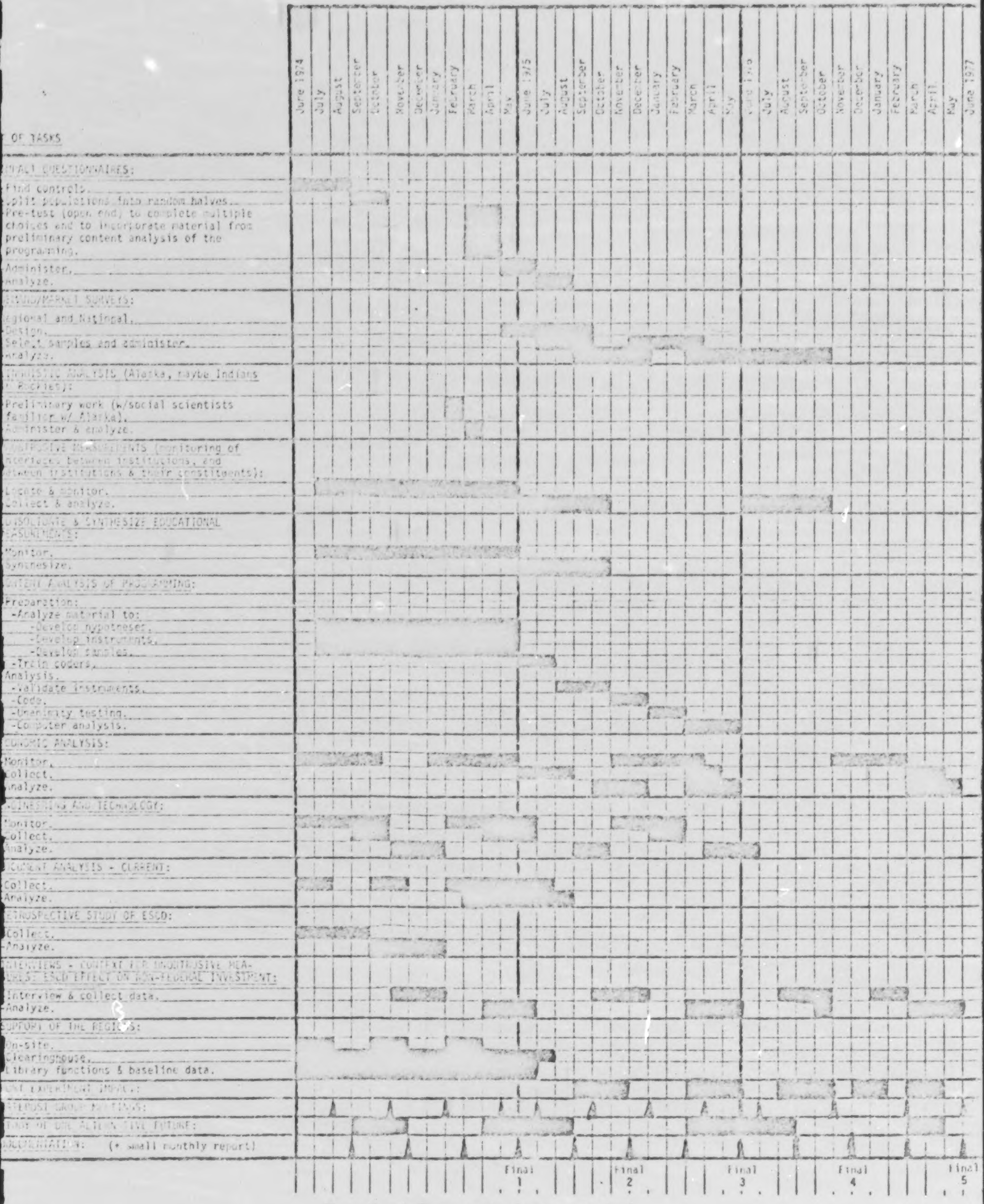
As a management auditor at the General Accounting Office, Mr. Turner conducted a financial and management review of Transpo 74. He assisted in a survey on the effectiveness of forms of financial aid to higher education at HEW/OE. While working in the International Division of the GAO, Mr. Turner conducted a comparative analysis of the U.S. Government's and OECD's share of exports to LDC's for the years 1969-1972.

While on active duty as a 1st Lieutenant in the Army Signal Corps, stationed at the National Security Agency, Mr. Turner was involved in basic research on an electron beam, archival memory system.

Earlier experience includes Mr. Turner's experimental research at Stanford University on the processing implication of films and plates used in the production of holograms. He was involved in the prototype development of an intermediate frequency receiver under a Navy contract.

Mr. Turner recieved his MBA from the George Washington University. His areas of concentration were financial analysis, investments, and economics. He received his M.S. from Stanford University, with concentration in digital systems and computer science, and his BSEE from the University of Connecticut. He was a Graduate Teaching Fellow at the George Washington University in the School of Government and Business, where he assisted in the preparation of a solution manual of a new edition of a financial investment book. He was a Lecturer in the Mathematics Department at the George Washington University and turored several quantitative business courses. He was also a Research Assistant at the Applied Electronics Laboratory of Stanford University.

X-C: OVERALL SCHEDULE



APPENDIX A

APPROACHES TO ESCD WHICH WE CONSIDERED BUT DISCARDED

The ESCD, as an experiment or as a model for future experiments and/or operations, suggests numerous sharply interesting areas of enquiry for both PCI and NIE. Selecting among them was not easy.

After identifying the relevant and interesting areas, PCI initiated a three step sifting process designed to define clearly the central issues addressed by the ESCD, and limit the final evaluation study to a manageable proportion.

First, PCI separated out those measures which would have intruded on the experimental process, resulted in a duplication of the local evaluation, or were simply impractical as to level of expense and effort required.

Secondly, the remaining areas of inquiry, interesting but not judged to be of central importance to the ESCD, were jettisoned.

Thirdly, we chose those issues from the surviving list for which reasonable data could be obtained, given the constraints of time and resources.

Thus, PCI's evaluation study represents those areas that we feel are important, essential, not duplicating efforts of local evaluators and do-able. The following were considered but discarded.

I. USER IMPACTS

1. Direct Educational Impact on the Individual
   Information from each of the three regional sites indicates that local evaluation teams will sufficiently concentrate on this area. As well as being redundant, an effort to assess individual impact requires a level of direct intervention inconsistent with PCI's

desire to remain unobtrusive
Scoreboard: Redundant, obtrusive

2. Insights into and Optimization of the Learning Process
   PCI regards insight into and optimization of the learning process as valuable areas of knowledge possibly derivable from the ESCD. These data areas will, however, be addressed by local evaluators in enough detail to make a similar PCI effort both duplicating and obtrusive.
   Scoreboard: Redundant, obtrusive.

3. Behavior Changes as Compared to Antecedents
   PCI suspects that there will be noticeable changes in behavior, over time, resulting from continued use of high technology in areas heretofore unaccustomed to such technology. PCI regards such changes in space and time perception, language, and conversation, career and migratory plans and attitudes towards "urban" areas as relevant data. The data is, unfortunately, difficult to collect without being obtrusive. Development of instruments and location of trained personnel - particularly in Alaska - make the project impractical.
   Scoreboard: Obtrusive, impractical.

4. Use of National Opinion Research Center or Comparable Testing Instrument in Assessing Demand
   PCI believes an assessment of the national demand and attitude towards the role of high technology telecommunications for public use is a valuable and necessary endeavor. However, discussions with NORC and other research groups convinced PCI that such organizations could not guarantee adequate enough sample detail or specific information collection to justify the high costs involved.

Further, normal sampling techniques such as the survey or questionnaire are frequently obtrusive as well as impractical - especially in isolated Alaska.
Scoreboard: Obtrusive, impractical.

II. MEASUREMENTS

5. Active and Obtrusive Data Collection During the Experiment Year

During the ESCD year, PCI is very sensitive about engaging in data collection or evaluation activity that could in any way interfere with or even alter the various experimental processes. Therefore, wherever possible during the ESCD year, PCI has established guidelines that ensure non-interference and guarantee unobtrusiveness to local evaluators and projects to the largest extent possible.
Scoreboard: Obtrusive.

6. Comprehensive Cost/Effective Analyses for Alternative Delivery Systems

Continuation plans for ESCD developed programs will depend, in large part, on alternative delivery systems available to the sites. The 88 selected sites, differing markedly from each other, present too many variables from which to begin defining specific site alternatives.

The magnitude of such an effort is enormous. PCI will, however, develop methodologies for costing alternative delivery systems, so that they can be rapidly developed once an alternative to the ESCD has been selected by the site or region itself.
Scoreboard: Impractical, redundant.

7. Development of Non-reactive, Direct Observation Techniques such as Voice Print-outs, Cameras, Measurement of Pupil Dilation

It is our current position that all that is required is ingenuity to use existing equipment properly reconfigured. However, it became clear that the amount of management attention required to effect this modest technological improvement was too great to warrant further attention during this study - especially as it became an increasingly low probability that we would allow ourselves even this level of direct intervention. However, the technology is not the limitation...A suitable device can be developed comfortably within the state of the art, and with no risk of interfering with the engineering liability of the receivers themselves.

The issue of unobtrusiveness, which is not a technological but an ethical issue, has not been resolved. Our team rejected entirely the "hidden" camera approach, although that is feasible, in favor of an "easily-forgotton camera" to make it clear that groups under observation were in fact under observation, and accepted that willingly.

Scoreboard: Impractical, obtrusive.

8. Calibration of Satellite Technology Use by Having Audiences Compare It to Other Media Available to Them

Study of the generally limited media and communication systems available at the ESCD sites (particularly Alaska and the Rockies) reveal that public radio is the only media source common to all, though even this is not certain. Thus, there are strong possibilities that no meaningful comparisons between the ESCD and alternative media use could be made, even if data collection could be unobtrusively designed and practically implemented.

Scoreboard: Obtrusive, impractical.

9. Grantee Innovativeness in Decision/Funding Management

PCI recognizes and is interested in the Appalachian Regional Commission and the Federation of Rocky Mountain States not only as conductors of the ESCD, but as experiments of a sort themselves.

Thus, PCI will not risk interference in these experiments by actively engaging in data collection aimed at determining grantee innovativeness. Rather, PCI will examine, as a case study, the "significant events" documents already being prepared in the Rockies as a means of looking at the issue.
Scoreboard: Obtrusive, redundant.

III. OTHER

10. Legal Implications of ESCD with Respect to "Open" Broadcasting

From its study, PCI has learned much about constraints. Initially, the major contraint on proliferation of domestic educational satellite systems was presumed economic. However, the role of Federal regulation and current litigation is also very important. PCI has chosen to limit its direct examination of this issue, but not to ignore it. The issue of legal constraints and their effect on future satellite programs will be addressed head-on at one of the Gate-post seminars to be convened as part of our evaluation effort. Further courses of action will be resolved at that time.
Scoreboard: Not a key issue, limited.

11. ESCD as a Model for Third World Use

Simply, Alaska is not India, and attempted extrapolation from ESCD Alaska to use in underdeveloped worlds might prove fruitless, if not futile. Given the many central and potentially productive issues to be explored, development of this model has not been pursued.

Scoreboard: Impractical, limited.

	Rationales:	Redundancy	Obtrusiveness	Impractical	Not a key issue	Limited
Deadends:						
User Impacts:	1	✓	✓			
	2	✓	✓			
	3		✓	✓		
	4		✓	✓		
Measurements:	5		✓			
	6	✓		✓		
	7		✓	✓		
	8		✓	✓		
	9	✓	✓			
Other:	10				✓	✓
	11			✓		✓

Definitions:

Redundancy: duplication of somebody else's effort.

Obtrusiveness: interference, perhaps altering, an experimental process.

Impractical: too expensive, not feasible.

Not a key issue: interesting area of enquiry, but not an issue of central importance.

Limited: valuable issue, but discarded due to need to focus study more sharply.

APPENDIX B

ORGANIZATIONAL IMAGE CHANGES RESULTING FROM SATELLITES

One aspect of organizational change is change in that organization's "image" -- how it perceives itself and is perceived by others. Organizational image, or the perceptions of what an organization is - why and what it is about - strongly influences what the organization is capable of undertaking and achieving. Educational institutions participating in satellite education may undergo changes in image which generate internal and external effects. Before discussing these effects, it is necessary to expand the concept of image.

Image* is comprised of two components -- doctrine and programs. Doctrine is the organization's raison d'etre, the most fundamental expression of why the organization exists. The Constitution, the Boy Scout Pledge, and corporate credos are statements of doctrine, the basic purpose of the U.S. Government, the Boy Scouts of America, and Fortune's 500 corporations. Doctrine is a relatively permanent expression of organizational purpose. (Doctrine can change only in a slow, evolutionary fashion.)

Programs are the activities undertaken by an institution to fulfill the objectives implied by the doctrine. Programs, the production and distribution of goods and services appropriate to institutional doctrine, are dynamic and have a limited life (a specific budget over a specific time). Programs can be created, continued, or dropped without changing the basic nature of the institution, but doctrine cannot be changed without a fundamental restructuring of the institution.

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* Image is one of three characteristics used to assess organizational viability. Under contract to the Agency for International Development, PCI is developing and testing a model which can determine when an institution is "viable." Image, money (financial resources and what they can purchase), and morale (human energy expended in pursuit of organizational objectives) interrelate to keep an institution viable. A viable institution is one engaged in valid transactions (sales of goods or delivery of services that replenish or increase money, image, and morale, and one that uses objective feedback on the consequences of these transactions.

Image is important to an institution because it tends to live up to the expectations held by those within the institution and those with whom the institution must come in contact. The institution's image is directly related to the power it can command in its daily "negotiating" processes. An example will illustrate how image influences what an organization is capable of achieving.

Consider a rather nondescript state university which through good fortune acquired a top-notch college football coach. Over a number of years the coach was able to build an average football team into a nationally-ranked powerhouse. State established an image of being a "great football school" in the minds of sports fans across the country who had never heard of the college in its less famous times. The local community, gifted by a new form of Staurday afternoon entertainment, develops a warm regard for State.

Both the coach and State University find their bargaining power enhanced in a number of ways. In compiling its budget, State makes certain that adequate funds are provided for the athletic department, even at the expense of certain academic departments (the struggling journalism school has not yet convinced the funding fathers of its importance. Its budget is raised only when its image is enhanced by a recent graduate who wins a Pulitzer Prize). The Athletic Director makes sure the football team's needs are taken care of before providing its mediocre basketball team with new uniforms. The community, justifiably proud of

State's image, fills the football stadium but stays home during the basketball season. An alumni booster club forms, and State finds that its donation solicitations no longer go unopened. The State Board of Education's capital budget reflects favorably on an expanded football stadium for State, but not for the junior colleges which need a stadium also. The coach has little difficulty in attracting outstanding high school players from all over the country who wish to further their "education." He is deluged by applications from assistant coaches in other colleges wishing to share in State's image. The coach has a strong voice in the policies of his league. The Mayor, blessed with two season tickets and a seat of honor at the annual football banquet, authorizes extra policemen for traffic control on game days. State's medical school becomes the recipient of a National Library of Medicine grant to study the effect of artificial turf on player injuries ("halo" effect). A number of positive benefits have accrued to State as a result of its new image.

As long as State's image as a great football school continues to be viewed positively by those internal to the institution (students, faculty, administration) and external (alumni, community, prospective students, envious coaches), State is capable of continuing to be a great football school. But should the football program lose its positive image (the faculty feels that the football program diverts too many resources from the school's basic mission -- educating students -- and rebels), it cannot long remain a great football school. Pressures will be brought to reduce the football budget. The coach is forced to reduce his coaching staff and State starts losing games. As State's great football image declines, good football players attend other colleges and a number of factors stimulate the decline. The Mayor becomes less friendly, alumni donations trickle down, and the coach's strong voice in league policies is no longer listened to. The decline in image precipitates a decrease in the bargaining power of the coach and the institution.

Back to the satellites and image. If an educational institution's self-image includes being innovative, or if it would like to have that image, it may choose to participate in satellite education (i.e., hire an outstanding coach). In order to begin satellite education, it is not necessary that all internal and external groups view the institution as innovative. It is sufficient that these groups are not hostile to the educational use of advanced technology.

The image enhancement resulting from satellite participation will manifest itself in a number of ways and increase the participating institution's bargaining power. Teachers viewing their school as progressive and exciting may increase their expectations of classroom performance (resulting from a heightened sense of professionalism and self-actualization). Students may also be excited by the satellite and exhibit increased learning motivation. Increased teacher and student expectations should result in improved classroom performance, not only for satellite taught courses but others as well.

Externally, the institution's image is also enhanced. Publicity regarding satellite education should create a favorable community reaction. Efforts to attract new faculty and retain present ones will be assisted. The school, now less dependent on the local school board, enjoys a greater variety of educational products. The new institution created to deliver satellite services to a large number of schools gives the local school a strong voice in regional or state collective lobby efforts, and provides the locals with a forum for exchanging new ideas. An organization that participates in satellite education may find it has created an image for itself that facilitates implementing other innovations.

In summary, satellite education should positively impact an educational institution image and increase that school's negotiating power (secondary hypothesis). Changes in the organizational interrelationships of participating schools directly address what may be an impediment to educational improvement -- the organization of conventional education (primary hypothesis).

An ethical question that lingers is the efficacy of allowing an institution to choose a strategy which will enhance its image and increase its power in day to day negotiation. While image-enhanced State may attract a disproportionate share of the limited star player pool, educational experimentation and innovation is fortunately not a zero-sum game. Experiments which meld technology with education and permit institutions to adapt appropriately can only increase our ability to educate, not at the expense of other institutions but for the benefit of all.

APPENDIX C

ALASKA

FAIRBANKS

ADLER PTA
REV JERRY TAYLOR
EIELSON PK BAPTIST CHURCH
24 MILE RICHARDSON HWY
FAIRBANKS AK 99701

DELTA JUNCTION PTA
RAY M BRYANT
MILE 274½ RICHARDSON HWY
VIA FAIRBANKS AK 99701

JOY PTA
MR WALLY HARRISON
1641 COTTONWOOD
FAIRBANKS AK 99701

MAIN JR HI PTA
MRS BARBARA COLE
1107 KODIAK
FAIRBANKS AK 99701

NORTH POLE PTA
MRS JANICE RODES
11½ MILE BADGER RD
FAIRBANKS AK 99701

NORDALE PTA
MR WILLIAM PARHAM
538 LIGNITE
FAIRBANKS AK 99701

RYAN JR HI PTA
MR JOHN MC KINNEY
931 - 3RD ST
FAIRBANKS AK 99701

HUNTER PTA
BOB HAMME
3743 SWENSON
FAIRBANKS AK 99702

JUNEAU

AUKE BAY PTA
BOB KRAMEK
17TH U.S. COAST GUARD DIST
BOX 35000
JUNEAU AK 99801

GLACIER VALLEY PTA
CMDR EDWIN L CUSTER
℅ U.S. COAST GUARD
P O BOX 3-5000
JUNEAU AK 99801

ANCHORAGE

CHUGACH PTA
MRS SUE LINFORD
745 WEST 13TH
ANCHORAGE AK 99501

FAIRVIEW PTA
HELEN MC FARLANE
941 B E 20TH AVE
ANCHORAGE AK 99501

INLET VIEW PTA
MR RICHARD A LYON
1411 WEST 13TH PL
ANCHORAGE AK 99501

CAMPBELL PTA
MR ROD DOWLING
817 W 72ND AVE
ANCHORAGE AK 99502

CREEKSIDE PARK PTA
MR PAT HURLEY
13372 DIGGINS DR
ANCHORAGE AK 99502

CHINOOK PTA
MR D E DONALDSON
8233 LOGANBERRY
ANCHORAGE AK 99502

SAND LAKE PTA
MRS EDITH FISHER
7632 WANDERING DR
ANCHORAGE AK 99502

WILLOW CREST PTA
MRS MARIAN ODDEN
1002 LANCASTER
ANCHORAGE AK 99502

GLADYS WOOD PTA
MRS PAUL SEELINGER
6754 BLACKBERRY
ANCHORAGE AK 99502

NORTH STAR PTA
MRS EUGENE W VIK
900 W 25TH
ANCHORAGE AK 99503

NORTHWOOD PTA
SHARON BODENSTEINER
2003 W 47TH
ANCHORAGE AK 99503

WOODLAND PARK PTA
MR JOHN THOMPSON
3811 BORLAND DR
ANCHORAGE AK 99503

AIRPORT HEIGHTS PTA
MR JOHN DOORE
1579 WINTERGREEN
ANCHORAGE AK 99504

COLLEGE GATE PTA
MR DONALD SPAFFORD
4938 MILLS DR
ANCHORAGE AK 99504

CLARK JR HI PTA
MR KEITH SEWART
6706 FOOTHILL CIR
ANCHORAGE AK 99504

CHESTER VALLEY PTA
MR GARY WALLACE
7131 CHESTER COURT
ANCHORAGE AK 99504

LAKE OTIS PTA
MRS HOWARD PELLETT
1671 HOMALO COURT
ANCHORAGE AK 99504

MOUNTAIN VIEW PTA
MRS MIRIAM THIER
532 N PINE ST
ANCHORAGE AK 99504

MULDOON PTA
MRS OLGA THIBAULT
7657 EAST 20TH
ANCHORAGE AK 99504

NUNAKA VALLEY PTA
MRS GENE GILMAN
1803 ATKINSON
ANCHORAGE AK 99504

ROGERS PARK PTA
DAVID R SHEPHARD
1320 REDWOOD CT
ANCHORAGE AK 99504

SUSITNA PTA
MRS JAMES POTTER
2120 CHANDALAR DR
ANCHORAGE AK 99504

SCENIC PARK PTA
MS BARBARA SCHMIDTMAN
7319 MADELYNNE WAY
ANCHORAGE AK 99504

TURNAGAIN PTA
MRS JERRY L PFAFF
3421 W 31ST AVE
ANCHORAGE AK 99504

WONDER PARK PTA
MR WILLIAM WEBSTER
413 BUNNELL ST
ANCHORAGE AK 99504

WILLIWAW PTA
MRS LYNN B KEOGH
4242 E 2ND
ANCHORAGE AK 99504

ABBOTT LOOP PTA
MS ELLA KING
9105 GRAVITE PL
ANCHORAGE AK 99507

O'MALLEY PTA
MRS HARVEY PRICKETT
SRA BOX 95-A
ANCHORAGE AK 99507

RABIT CREEK PTA
MS PAUL JACKSON
STAR RT A BOX 251
ANCHORAGE AK 99507

TUDOR PTA
MR DON FROST
1921 BARTLETT ST
ANCHORAGE AK 99507

TAKU PTA
MR E M FLYNN
2621 SOLOMON AVE
ANCHORAGE AK 99507

PTAMMIGAN PTA
MR DONALD BYKOFF
BOX 654
ANCHORAGE AK 99510

YAKUTAT

MONTI BAY PTA
MRS RENONA
P O BOX 22
YAKUTAT AK 99689

ARIZONA

TUBA CITY

TUBA CITY PTA
MRFEARN VEST
P O BOX 423
TUBA CITY AZ 86045

IDAHO

OSBURN

OSBURN PTA
STEVEN M COTTAM
BOX 708
OSBURN ID 83849

NEVADA

CARLIN

CARLIN PTA
MR HAROLD HUSTEAD
P O BOX 493
CARLIN NV 89822

ELY

EAST ELY PTA
LAUREL SCHOTT
P O BOX 941
ELY NV 89301

ELY GRADE PTA
MRS LESLIE HERRERA
1600 MILL ST
ELY NV 89301

LUND PTA
MR LEWIS CRIPPS
PRESTON RT
ELY NV 89301

ELKO

ELKO SOUTHSIDE ELEM PTA
JAMES TAYLOR
℅ GENERAL DELIVERY
ELKO NV 89801

BATTLE MOUNTAIN

BATTLE MOUNTAIN PTA
RON JULIAN
BATTLE MOUNTAIN NV 89820

NEW MEXICO

DULCE

DULCE ELEM PTA
JOYCE MAUER
DULCE SCHOOLS
DULCE NM 87528

UTAH

ENTERPRISE

ENTERPRISE PTA
MRS DOUGLAS JONES
206 EAST MAIN
ENTERPRISE UT 84725

HEBER

WASATCH COUNTY PTA
MRS BILL COLEMAN
148 WEST CENTER
HEBER UT 84032

KANAB

KANAB PTA
JERRY BOWLES
KANAB UT 84741

KANAB HI PTA
MRS DOYLE FRANKLIN
KANAB UT 84741

PANGUITCH

PANGUITCH PTA
MRS MARETTA MYER
PANGUITCH UT 84759

HYRUM

HYRUM LINCOLN PTA
MRS DERRELL C PETERSON
159 EAST MAIN
HYRUM UT 84319

WYOMING

SARATOGA

SARATOGA PTA
MRS DOUGALS WILSON
P O BOX 964
SARATOGA WY 82331

RIVERTON

ASHGROVE PTA
IRIS TROVER
404 E PINE
RIVERTON WY 82501

GAS HILLS PTA
MR DUANE BAKKER
GAS HILLS STATION
RIVERTON WY 82501

LINCOLN PTA
MRS EDMUND BARTEL
1502 PERSHING
RIVERTON WY 82501

DUBOIS

DUBOIS PTA
MR ALBERT SNYDER
BOX 45
DUBOIS WY 82513

LOVELL

LOVELL PTA
MRS REED WILLIAMS
RT 1 BOX 21
LOVELL WY 82431

APPENDIX D

CULTURAL INDICATORS
The Social Reality of Television Drama

Proposal for the renewal of a research grant

by George Gerbner and Larry Gross
The Annenberg School of Communications
University of Pennsylvania

A. INTRODUCTION

Man becomes a particular kind of human being through his use of symbols. Social regularities in human behavior cannot be understood in isolation from cultural regularities in the symbolic environment. And when the symbolic environment itself is changing, the quality of social health and behavior can best be assessed if we know which way the cultural tides flow. The purpose of Cultural Indicators is to provide such information.

This study continues previous research and a successful pilot project on the feasibility of indicators of the relationships between pervasive cultural trends represented by network television drama and popular conceptions of reality in critical areas of health, behavior, and policy. The project thus builds on the results of prior support by foundations, commissions, and agencies* and responds to needs and directions for priority research expressed in recent HEW and NIMH statements and reports.

A conference of staff and outside researchers and representatives of government and private agencies was held to advise NIMH on research to follow up and further develop the work of the Surgeon General's Scientific Advisory Committee on Television and Social Behavior. The report of that conference, attached as Appendix B, recommended continued attention and research support to long-term, broad impact studies based on prior work in

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*Including the U.S. Office of Education, the National Science Foundation, UNESCO and the International Sociological Association, the National Commission for the Causes and Prevention of Violence (Eisenhower Commission), the Surgeon General's Scientific Advisory Committee, and the National Institute of Mental Health. The key publications by the senior investigator which report theoretical and methodological developments stemming from these studies, and on which this proposal draws, are: "Toward Cultural Indicators: The Analysis of Mass Mediated Public Message Systems" in *The Analysis of Communication Content: Developments in Scientific Theories and Computer Techniques*, co-edited with Ole R. Holsti, Klaus Krippendorff, William J. Paisley and Philip J. Stone (Wiley & Sons, 1969); "Cultural Indicators: The Case of Violence in Television Drama," *The Annals* of the American Academy of Political and Social Science, 388:69-81, March, 1970; "Cultural Indicators: the Third Voice" in *Communication Technology and Social Policy*, co-edited with Larry P. Gross, and William H. Melody (Wiley & Sons, 1973). A popular article on "Communication and Social Environment" in the September 1972 *Scientific American* sketches the broadest context in which this research is conceived, and is attached as Appendix A.

this area. The report specifically noted "The need for continuous monitoring, across time and across cultures, of what has been called the symbolic environment. . . We need a better understanding of this 'mainstream,' before we can realistically talk of intervention for change" (p. 9).

A similar conference on indicators of televised violence also recommended broad-gage research placing the issue of violence in the context of a more general assessment of television effects. The report of that conference is attached as Appendix C. Its recommended "violence profile" is one of the indicators included within the scope of the proposed research. Furthermore, this proposal is also responsive to the report's recommendation that ". . The next step is to somehow link studies of viewers' perceptions of violence and its effects with the kind of sophisticated analysis of program content being carried out under the Annenberg School's project" (p. 6). Finally, in a letter of May 12, 1972, the then Secretary of HEW Elliot L. Richardson wrote Senators Pastore and Magnuson that the pilot project "to develop indicators of trends in prime-time television dramatic content and of their effects" including "its context and meaning to the viewer" is "essential to larger efforts to monitor TV violence regularly in a meaningful way useful to those responsible for planning social policy." (See Appendix D.)

1. Objective

The basic assumption underlying this study is that television drama is in the mainstream -- or is the mainstream -- of the symbolic environment cultivating common conceptions of life, society, and the world. No member of society is unaffected by its dominant cultural trends. However, living deep in the mainstream, being a heavy consumer of its images and messages, mean more intensive acculturation and tighter integration of the myths and rituals of the symbolic world into one's view of how the real world works than does living a more insulated life or in a more independent or diversified cultural context. Therefore, while all Americans are influenced by the persistent symbolic structures of the cultural mainstream, more heavy viewers of television than light or non-viewers tend to conceive of reality as they experience it in the symbolic world of television drama.

The pilot study* provides evidence of the plausibility of these assumptions and the feasibility of definitive research along these lines. A comprehensive and cumulative analysis of the symbolic world of television drama was related to images and conceptions of social reality held by children and adults in such areas of knowledge as geography, demography, personal and group stereotyping; age, sex, ethnic, etc., occupations, power, and other role expectations;

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*The NIMH announcement of the scope and purposes of the pilot project is attached as Appendix E.

judgments of personalities and groups as to probabilities of success and failure, violent and friendly relations, winning and losing, etc.; and issues such as crime and victimization, family life, aging, addiction, minority group relations, and so on. The cultivation hypothesis was of course most testable in those aspects of social reality in which the "facts of life" in the symbolic world of television drama diverge from those of news and/or of the "real" world. The pattern of findings is remarkably consistent. It shows that the world of television drama does cultivate dominant conceptions of life and society even (or especially) when the real-life facts (or overt values) hold otherwise. The findings of the pilot project also indicate that those most integrated into the symbolic mainstream (the heavy consumers of its products) are the most likely to use its fictional structure to define the real world of people, places, and values.

These findings represent the first clear-cut demonstrations of significant media effects upon imagery and knowledge of critical social import. The effects are on a more basic level than those of attitudes, opinions, and campaigns of information or persuasion (which is where most previous research was conducted). They go to the very definitions and assumptions of the facts of life and society cultivated by massive and repetitive social symbolic functions of everyday "fantasy" output.

The proposed study will systematize, formalize, and, in a sense, institutionalize the regular collection and periodic reporting of such information. The mapping of the symbolic world and the tracing of its effects with respect to both general conceptions of social reality and a set of critical public issues such as education, health, violence, public authority, law observance, and domestic and global group relationships will be developed into a cumulative and comparative research enterprise. At the conclusion of the proposed project, the theory, methodology, and presentational techniques for the annual reporting of a set of multi-dimensional comparative indicators will be available for the continuing mapping and interpretation of the image and knowledge cultivation characteristics of American television.

Why television drama

Television dominates the prevailing climate of the mass-produced symbolic environment. Its dramatic programs (plays, films, cartoons) cultivate synthetic images of life, society, and the world. Their perception as "entertainment" assures, if anything, relatively easy and universal participation in the usually realistically depicted fantasy world they present. Never before have such large and heterogeneous publics -- from the nursery to the nursing home, from ghetto to penthouse -- shared so much of a system of messages and images, and the assumptions embedded in them. What do these images and messages cultivate in common? What do they teach differently to children and adults, to men and women, and to various social groupings? How do the symbolic structures and their functions change over time?

Fiction and drama offer special opportunities for the cultivation -- and, therefore, analysis -- of elements of existence, values and relationships. Here an aspect of life, an area of knowledge, or the operation of a social enterprise appears imaginatively re-created in its significant association with total human situations. The composite "worlds" of fiction and drama can reveal social mechanisms underlying, but not necessarily apparent in, other modes of presentation. Those who neither seek nor would select a wide range of specialized subject matter will find it, nevertheless, in drama and fiction. Most people, and especially the young and the less educated of all ages, encounter most subjects in the form of such "incidental" treatment in the course of their relatively non-selective leisure-time "entertainment."

What is true for the presentation of miscellaneous subject matter applies even more to the cultivation of personal and social characteristics, stereotypes, values, policies, and norms of conduct. Unlike life, the bulk of popular fiction and drama is an "open book." Characterizations are relatively clear-cut, motivations are transparent, problems and conflicts are explicit, and the interplay of forces that determines the outcome, as well as the outcome itself, are usually clear. These characteristics of everyday fiction and drama make them the most common and accessible source of public acculturation.

The research leading to cultural indicators began, therefore, with the analysis of the most pervasive and comprehensive images of everyday culture found in television drama. For most Americans most of the time television _is_ popular culture. The symbolic structures and functions of the message systems found in television drama have provided the basis for an investigation of the assumptions, conceptions, and tendencies cultivated in their viewers. The pilot project gave striking evidence of such cultivation among heavy viewers. The next and final phase of research development should establish and demonstrate the theoretical and practical usefulness of cultural indicators as guides to scientific understanding, citizen and consumer behavior and public policy in communications and culture.

Overlapping stages

The project is planned in overlapping stages. The first stage will see the development and launching of cultural indicators based on prime-time network television drama. The annual analysis of the dramatic material will provide the basis for measures of cultivation in selected areas. The first annual report combining message and cultivation analyses, and yielding such trend indices as will be available by that time, will be completed in the third year.

During the second stage (beginning with the second year) the project will formalize the statistical procedures and computer techniques appropriate to a standardized system of data processing and reporting. At the same time, cross-national effort of cooperating research teams will be organized. The first set of comparative findings will be available by the end of the grant period.

2. Background

A series of national and cross-national studies provides both a data base and a starting point for the proposed research. The analytical framework has emerged from these studies. They have demonstrated that the mass-cultural presentations of many aspects of life and types of behavior place them in public context that serves institutional purposes.

Wartime concern with mental health led to the passage of the National Mental Health Act in 1946, the establishment of the National Institute of Mental Health, and the emergence of the "mental health movement" of the fifties. By 1953 John R. Seeley could observe in The Annals of the AAPSS that "This concentration upon, and heightened consciousness of, the nature of mental life is now so widespread as to ensure an appreciative audience for New Yorker cartoons about psychiatrists, Hollywood films about alcoholism or amnesia, mothers-aid books about the emergent little superegos and their resugent little ids."* NIMH began sponsorship of a series of studies on popular conceptions of mental health. The senior investigator of the proposed project joined in the research on how mental illness is presented in the press and in popular drama and fiction. We looked at the processes of control and decision-making that gave rise to specific content configurations in public information and entertainment. We studied the dynamics of image-cultivation on terms related to the composition of the message systems involved. The research was completed by 1960.** It represents a valuable data base and benchmark for continuing and comparative analysis.

Sputnik generated (for reasons peculiar to American culture) an orgy of educational soul-searching. Under a grant from the U.S. Office of Education the senior investigator studied the portrayal of schools, teachers, and students in the mass media of ten countries. Again we traced the ebb and flow of attention and the composition of factual and fictional representations that cultivated popular conceptions of education in the U.S., four countries of Western Europe, four countries of Eastern Europe, and the Soviet Union.* A principal value of that research also is as a comparative baseline for periodic indicators of popular cultural trends.

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*John R. Seeley, "Social Values, the Mental Health Movement, and Mental Health," The Annals of the American Academy of Political and Social Science, Vol. 286 (March 1953), p. 22.

**George Gerbner, "Mental Illness on Television: A Study of Censorship," Journal of Broadcasting 3:292-303, Fall, 1959; Cf. Jum C. Nunally, Jr., Popular Conceptions of Mental Health; Their Development and Change (New York: Holt, Rinehart & Winston, 1960); George Gerbner, "Psychology, Psychiatry and Mental Illness in the Mass Media: A Study of Trends, 1900-1959," Mental Hygiene 45:89-93, January, 1961; George Gerbner and Percy H. Tannenbaum, "Regulation of Mental Illness Content in Motion Pictures and Television," Gazette 6:365-385, 1961.

UNESCO, the International Sociological Association, and the National Science Foundation supported a six-nation "Cross-Cultural Study of Films and the 'Film Hero.'" One year's feature film production in the U.S., France, Italy, Yugoslavia, Poland, and Czechoslovakia provided the basis for a comparative investigation of the fictional worlds and "culture heroes" of the major single source of imaginative representations shared across national boundaries.**

In 1968, the senior investigator received a research contract from the National Commission on the Causes and Prevention of Violence to conduct an analysis of the extent and nature of violent representations in prime time network television drama for the 1967 and 1968 seasons. The findings provided part of the factual basis for the Commission's recommendations, and were reported in its Mass Media Task Force report.*** Subsequently, under a grant from the Surgeon General's Scientific Advisory Committee on Television and Social Behavior, the study was extended to cover 1969 and 1970 television seasons,**** and the analysis continued under NIMH auspices in 1971 and 1972.*****

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*George Gerbner, "Mass Communications and Popular Conceptions of Education: A Cross-Cultural Study." Cooperative Research Report No. 867 (U.S. Office of Education, 1964); "Smaller Than Life: Teachers and Schools in the Mass Media," Phi Delta Kappan 44:202-205, February, 1963; "Images Across Cultures: Teachers in Mass Media Fiction and Drama," The School Review 74:212-229, Summer, 1966; "Education About Education by Mass Media," The Educational Forum 31:7-15, November, 1966; "Newsmen and Schoolmen; the State and Problems of Education Reporting," Journalism Quarterly 44:211-224, Summer, 1967; "The Press and the Dialogue in Education; A Case Study of a National Educational Convention and its Depiction in America's Daily Newspapers," Journalism Monograph No. 5, 1967; "Teacher Image and the Hidden Curriculum," The American Scholar, 42:66-92, Winter, 1973.

**George Gerbner, "The Film Hero; A Cross-Cultural Study," Journalism Monographs No. 13, 1969.

***Violence and the Media, a report to the National Commission on the Causes and Prevention of Violence prepared by David L. Lange, Robert K. Baker, and Sandra J. Ball. U. S. Government Printing Office, Washington, D.C., 1969. (See Chapter 15 and Appendix III-J.)

****George Gerbner, "Violence in Television Drama; A Study of Trends and Symbolic Functions," in Television and Social Behavior, Vol. 1, Content and Control, edited by G. A. Comstock and E. A. Rubinstein. Washington: Government Printing Office, 1972.

*****George Gerbner, with the assistance of Michael F. Eleey and Nancy Tedesco, "The Violence Profile; Some Indicators of Trends in and the Symbolic Structure of Network Television Drama 1967-1971," in Hearings Before the Subcommittee on Communications of the Committee on Commerce, U.S. Senate, U.S. Government Printing Office, 1972.

Finally, the pilot project leading to the present proposal was supported by a 2-year NIMH grant commencing January 1, 1972. (See Appendix E.) Beyond continuing the television content analysis, that project was devoted to the further refinement of the instruments of analysis and the development of interview and survey methods applicable to children and adults in the assessment of the imagery and knowledge that TV's dramatic content might cultivate.

These studies represent cumulative conceptual and methodological investment in establishing the basis for the definitive research of a broad and multidimensional nature proposed by the investigators and called for in the statements attached as Appendices B, C, and D.

3. Rationale

Imagine a hermit who lives in a room which is linked with the outside world via a television set that can only receive dramatic programs. This person's knowledge of the world would be built exclusively out of the images and "facts" which he could glean from on an unending diet of fictional events.

What would exist in this man's world? Obviously, only those persons, objects, places and events that are depicted in television drama. What would seem important in this world? Clearly, the importance of the various elements of his "reality" would be determined by the frequency of their appearance and by the centrality of their roles. Similarly, the ways in which the various constituents of the television world are portrayed and organised would be the only source of his knowledge of their value and of their interrelationships. The population of his world would be the population of television drama; his expectations and judgments would be derived from the conventions of plot and outcome that dominate television drama; his view of human nature would be based on the shallow psychology of central-casting characterization.

While few are likely to find themselves solely dependent upon television drama for their knowledge of the world, it seems worth asking how much our view of the world actually resembles that of our hypothetical hermit. And, possibly more importantly, how similar will a child's world be, given relatively little exposure to the complexities of the "real" world and a steady diet of exposure to the world of television?

All art is based on conventions that govern the selection and organization of elements. The skill of the individual artist is only visible against the background of the stylistic conventions of his period and medium.* The dominant stylistic convention of Western narrative art -- novels, plays, film, TV drama -- is that of representational realism.** The premise of realism as a stylistic convention even of fantasy materials such as cartoons has important implications. It makes the audience respond as if the artist's choices were governed not by the conventions of art but by the facts of life. However stereotyped the plots are, we assume that they take place against a backdrop of the real world -- the details must be naturalistic or we feel that something is wrong. Characters must behave as people would in most situations. The conventions of character development are those of Sunday-supplement psychology. When the impossible does occur it will often be treated as if it, too, were part of a natural order in which nuns could fly and animals speak. Nothing impeaches the basic "reality" of the world of fictional entertainment.

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*Larry P. Gross, "Art as the Communication of Competence," Social Science Information, (UNESCO, in press).

**The pilot study found 96 percent of all television plays (other than cartoons) to be realistic in style.

This picture of the conventions of realism may not fit the facts of "high culture" or avant-garde art in our time, but it is certainly appropriate for the world of television drama. The world of television drama is the world we live in. It is also the world of the past as we think we know it, and often of the future as, perhaps, we have come to expect it.

If the premise of realism in television drama seems a bit thin for some adult viewers, it is certainly plausible for most children who are not as skilled at discerning the evidence of "poetic" license. A study completed recently by James Murphy, a member of the staff of the pilot project, has shown the extent to which children will respond to a story shown them in the form of photographic slides by stating that it was "real" -- that it really happened.* Greenberg's study of "Children's Reactions to TV Blacks" found the effects of TV exposure generally even more marked and judged more "real to life" than that of personal encounter.**

Television drama, operating on this premise of realistic depiction, offers the viewer an apparently rich array of windows through which he can glimpse apparently diverse images and events. But the diversity is only in the shape of the window and the angle of the glimpse -- the basic topography of the fictional world is constant. It is also highly informative. That is, it offers to the unsuspecting viewer a continuous stream of "facts" and impressions about the ways of the world, the constancies and vagaries of "human nature," and the consequences of actions. The premise of realism is a Trojan horse which carries within it a highly selective and purposeful image of the facts of life.

What is this image of the world, what are the lessons of this hidden curriculum, and are they indeed learned by the unsuspecting pupils of television? These are the questions which we are addressing in an attempt to analyze the critical symbolic messages of television drama and to trace their impact on the beliefs and values of its audiences.

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*James P. Murphy, "Investigation of the Nature and Development of Interpretive Competence," paper presented at the International Communication Association, Montreal, April, 1973.

**Bradley S. Greenberg, "Children's Reactions to TV Blacks." Journalism Quarterly, 50:5-14, Spring, 1972.

4. Progress report

A major objective of the pilot project was that of methodological development and instrument-testing. However, early indications of the substantive findings coming from the testing provided strong indication of significant results. If these are born out in the main project now proposed, as we fully expect them to be, the proposed study will represent the first clear-cut evidence of massive influence of television viewing and other media exposure upon public conceptions of social reality.

This report was delayed until some of the results could be included, even though the pilot project still had more than six months to go. At the same time, and for the same reason, it was not possible to provide more than a few highlights and a sketchy rather than comprehensive account of the findings.

a. Period

The period of time covered in this progress report is the first 17 months of the 2-year pilot project, from January 1972 through May 1973.

b. Summary

The nature of the world portrayed in prime time television drama and its effects in cultivating conceptions of social reality was the subject of this pilot study. Reliable methods for the analysis of dramatic message systems were developed and applied. Semi-projective picture tests and a questionnaire survey were developed and administered.

Six years' accumulation of analytical material was the data base upon which the television content study proceeded and which will be updated annually in the proposed main study. The results of the pilot study featured stylistic, demographic, occupational, and dramatic action (mostly crime and violence) aspects of the television world, and pointed up the importance of a detailed analysis of the facts of the "message" before undertaking a study of its presumed effects.

Major methodological and substantive developments in the study of cultivating effects can be reported here. Several picture tests administered to different groups of white and black children revealed both the general and the specifically TV-related existence of those stereotyped conceptions of people and their probable fates that was also found to be characteristic of the television world. A telephone questionnaire administered to a national probability sample of heavy and light television viewers further demonstrated significant associations of television exposure with conceptions of salient aspects of social reality.

c. Detailed report

We undertook to develop methodologies for the reliable observation of "facts of life" of the world of television drama, and to create tools and procedures for the assessment of the conceptual consequences of "living" in that fictional world. The first type of research we call the analysis of message systems. The second is the study of the conceptions they tend to cultivate among those most heavily exposed to them. In testing the cultivating effects of the "facts of life" in the world of television drama we relied primarily on those "facts" that diverge from the "real world" as represented in factual statistics and possibly news accounts.

Message system analysis. Network dramatic programs transmitted in prime time (7 through 11 p.m.) and all day Saturday for one full week in the fall of each year (after the launching of the new season) comprised the annual samples on which message system analysis was performed by trained coders. The training consisted of multiple codings following an instrument of analysis and the screening and final selection of coders on the basis of the results of a diagnostic procedure.

The reliability of the analysis is also measured by multiple codings and the application of appropriate formulae for the assessment of the reliability of coder observations (see "Methods of Procedure," below).

The instrument of analysis used in this pilot study had three parts. Part A was devoted to the systematic observation of those "facts of life" in the world of television drama that pertain to a program as a whole: style, time, place, setting, group relations, thematic structure. Part B dealt with the demography, health, personality profile, value structure and selected relationships of the cast of characters populating the television world. Part C pertained to the intensive study of selected types of dramatic action.

Six years of research made available to the project the analysis of 656 programs (plays), 1907 leading characters, and 3505 acts or episodes. The rich and complex cumulative archives of this project will take time to digest, formalize, and report in a systematic and periodic fashion. Thematic trends appear to be remarkably consistent despite apparent fluctuations of style and the popularity of different formats. Only a few highlights of this analysis can be noted here.

More than nine out of ten dramatic programs (other than cartoons) are "realistic." The world of television is mostly domestic, urban, and contemporary. Foreigners make up 14 percent of its population. The fantastic and the implausible are more likely to occur far out in the country, or in other countries, than close to home. Wars, small towns, places of great wealth and poverty, and sparsely populated areas are more likely to be found abroad than in the U.S.

The past is rarely and the future is never comic. Poverty is funnier than wealth, even if it is rare (once in a hundred settings) and far away. Most of those employed in the world of television drama are professionals, but most are also unmarried and in the prime of life. Business, government, entertainment, law enforcement, and crime are the major occupations. Half of all people commit violence, one fifth perpetrate some crime, six percent kill someone and three precent are killed.

Males outnumber females four to one. Children's cartoons portray even fewer women and more violence. Children and old people are hard to find; each comprise only about six percent of the television population. More females than males are young, but women age earlier and faster than men. The aged are more likely to be evil, and thus to fail, than the more youthful.

Social power on television is demonstrated in the pattern of violent action. Although in 1972 the violence index was at its 1970 level (slightly below 1971), and the number of violent characterizations declined somewhat, the rate of violent episodes rose and the ratio of victimization was the highest in six years. (See Appendix F.) That ratio, the number of victims for each violent character, might be considered an indication of domination and possibly fear cultivated in the television world. The victimization ratio for the last six years was:

1967	1.16
1968	1.13
1969	1.21
1970	1.09
1971	1.10
1972	1.26

Thus the absolute amount of violence is not necessarily a good measure of its functions in shaping conceptions of social reality. For example, the victimization ratio for white males was 1.13, for other males 1.18. The same ratio for all males was 1.14, for all females 1.39. The charts on page 157 of Appendix A also illustrate how the power structure of the television world victimizes females and nonwhites, even among cartoon "animal" characters.

The next question is how the social symbolic context of the television world affects the prevailing cultural climate and cultivates viewers' conceptions of the facts of life. That is the question addressed in the cultivation analysis part of the pilot (and the proposed) project.

Cultivation analysis. Semi-projective picture tests and a questionnaire administered to different groups of respondents were the principal methods for the assessment of the dominant imagery and cultivation effects attributable to television. The picture tests were developed with relatively small groups of children, most of whom are moderate to heavy viewers of television. The purpose was mainly to develop relatively non-structured (and nonverbal) measures of imagery usable with children, and to test their efficacy in eliciting responses that could be related to general cultural stereotypes presented on and presumably cultivated by television. The specific cultivating effects were tested in one of the picture tests and then by the questionnaire on a national probability sample of heavy and light viewers matched on some other characteristics and also grouped by some other media habits.

The first set of semi-projective materials consists of a large set of passport-type passport-type photographs of a heterogeneous group of people taken by us under standard conditions. The pictures have been reliably coded in terms of race, sex and age, and can be put together in various ways. We have used somewhat different sets for different purposes. We are currently testing a standardized set of 40 pictures which is divided into equal subgroups of black and white, male and female, young (18-30) and older (35-60), We have had copies of this set printed on large sheets of heavy paper, randomly ordered and coded numerically for group and individual testing (a copy is included as Appendix H). In addition, we can utilize groups which represent other population segments, for example, elderly or Asians.

We have used these pictures to examine the questions of violence and victimization. In the world of television the "victimization ratios" demonstrate the power of the white and the male over the non-white and female. When we asked children to make judgments about our picture-set people, we found very similar patterns. Using one method, we asked groups of children (aged 8-10) to rate each picture in a set of 40 (20 male, 20 female; 20 young, 20 old; all white), in terms of the likelihood that the person might murder someone, be murdered, or, in a dichotomous choice, kill or be killed. Some were also asked to answer the questions as though these people were all characters from television patterns. The data are very clear (see Table 1). The killers are the young and the male, the victims are young females and older males.

Another group of children was asked to pick out of a bi-racial set all of those who might be murderers and all who might be the victims of murder (not mutually exclusive). They were also asked to make the same choices in terms of TV -- that is, which of the people would be likely to murder or be murdered if they were all characters on television. The ratios of murderers to victims by race and sex (Figure 1) show a pattern which is familiar to television viewers, and reminiscent of our analysis of television drama. White males are equally murderous and victimized, black males are mainly murderous, black and white females are victimized. Children see the pattern essentially the same in terms of life and television. The generation difference also shows up here. The young males are more murderous; the old, especially old women are overwhelmingly victimized.

In another test, a group of white and black public school children was asked to pick three characters out of a set of 40 according to the following plot: there is a hero who will oppose and defeat a villain, and save an innocent person who has been victimized by the villain. The heroes chosen by the children were young (73%), male (61%) and white (58%). The villains were also young (70%), male (67%) and white (58%). The victims were more evenly distributed -- 58% young, 52% male, 57% white. Also of interest is the tendency for blacks to choose white characters and females to choose male characters. Females chose twice as many male heroes than males chose females for the hero role.

For another group of black junior high school children we compared the role-portrait choices of the heavy and the light television viewers. The comparisons are in Table 2. (Note the relatively high levels of television viewing in both groups.) The most striking differences are in the choice of heroes (heavy viewers choose more males) and victims (heavy viewers choose more females), which tend to follow the lines of television drama. Heavy viewers also pick more whites as heroes and victims, though not as villains.

TABLE 1: Children's Responses: Violence Probabilities

Question No.1: How likely is each person to murder someone (1-5) ? (N=10)*

	Young	Old
Male	3.6	2.9
Female	3.1	2.2

A. Male vs. Female: p.= .001
B. Young vs. Old: p.= .001
C. Sex vs. Age n.s.

Question No.2: How likely is each person to be murdered (1-5) ? (N=10)*

	Young	Old
Male	2.6	3.4
Female	3.2	2.6

A. Male vs. Female: n.s.
B. Young vs. Old: n.s.
C. Sex vs. Age: p.= .001

Question No. 3: How likely is each person to kill (5) or be killed (1) ? (N=10) *

	Young	Old
Male	3.8	3.1
Female	3.0	2.2

A. Male vs. Female: p.= .001
B. Young vs. Old: p.= .001
C. Sex vs. Age: n.s.

Question No.4: How likely is each person to kill (5) or be killed (1) on TV? (N=10)*

	Young	Old
Male	3.7	3.0
Female	2.8	2.5

A. Male vs. Female: p.= .001
B. Young vs. Old: p.= .002
C. Sex vs. Age: n.s.

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* All Ss are children, 8-10 years old.

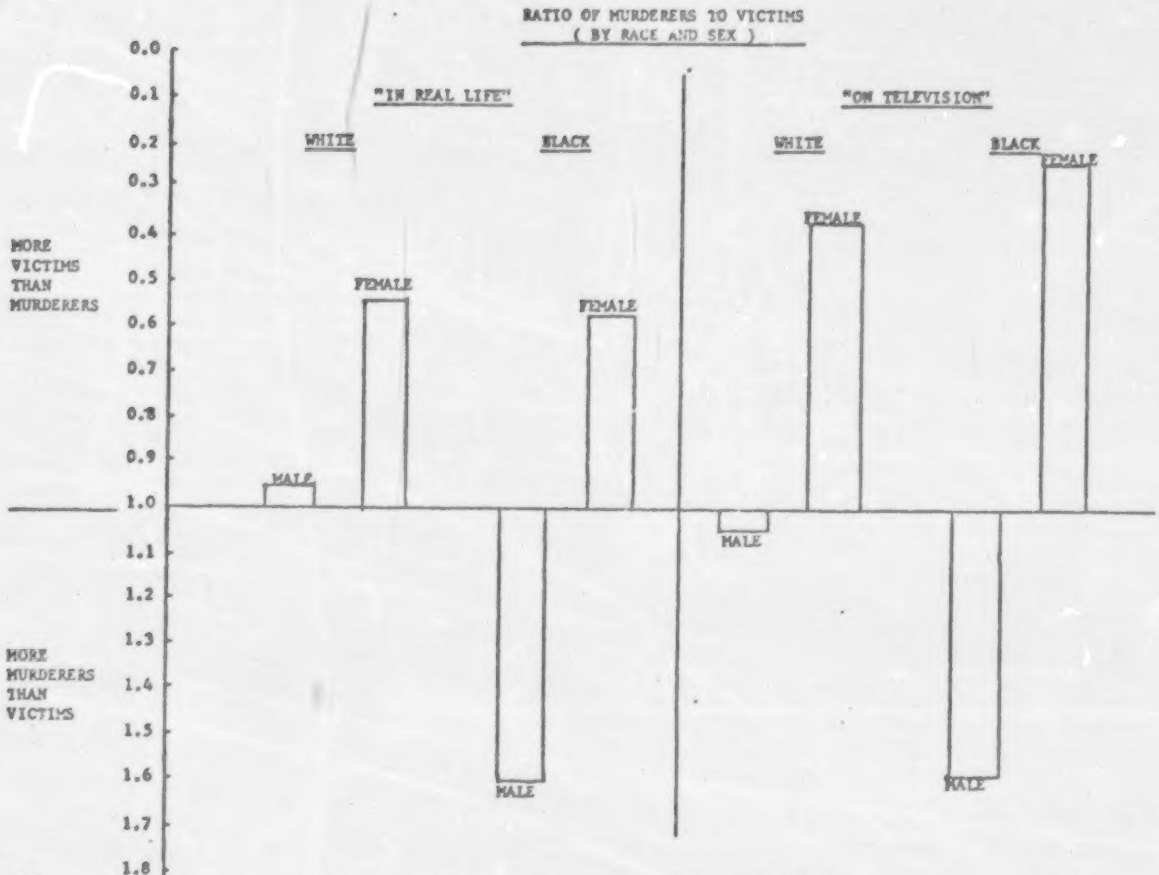

FIGURE 1: Children's Responses: Comparative Ratios

TABLE 2: Role-Portrait Choices and Television Viewing Habits for 23 Black 9th-grade Students

ROLE	SEX MALE	 FEMALE	RACE WHITE	 BLACK
I. WINNER -- HERO				
LIGHT VIEWERS (1-6hrs):	62.5%	37.5	--	100.0
HEAVY VIEWERS (7-15hrs):	73.2	26.5	33.5	66.5
II. LOSER -- VILLAIN				
LIGHT VIEWERS (1-6hrs):	100.0	--	37.5	62.5
HEAVY VIEWERS (7-15hrs):	93.2	6.6	33.0	67.0
III. VICTIM				
LIGHT VIEWERS (1-6hrs):	37.0	63.0	12.5	87.5
HEAVY VIEWERS (7-15hrs):	20.0	80.0	40.0	60.0
]

We have also done some pilot work with a very different set of photographs. These are pictures of scenes which include two or more people in interaction, and resemble the ambiguous stimuli of the Thematic Apperception Test. (For some examples see pages 154 and 155 of Appendix A.) We have produced these pictures in two formats, one of which appears to have been taken from a television screen. We have given these pictures, in both formats, to respondents who are asked to tell us what they think is happening, who the characters are, and what the outcome is likely to be. It is premature to give results, but the method seems fruitful, and we are hopeful that we will be able to obtain interesting data in this way.

* * *

Out strategy for the investigation of television effects upon specific facts and conceptions of social reality begins with the analysis of the world of television drama. We then compare the facts of life on television with those available for parallel aspects of the "real world." To give a relatively simple example, most criminal cases involving violence are decided by judges. On television, however, courtroom trials are an important dramatic arena, and guilt or innocence are usually determined by juries.

Our next step is to ascertain what respondents -- adults and children, viewers and non-viewers -- think is the true state of affairs. By matching the judgments of our respondents with the data derived from our analysis of television drama and from real-life sources we can build a composite picture of the relationships between these three images of the world. In many cases it is possible to trace a line extending between the image of the world via television and that image which presumably reflects the true world of fact -- and then place our respondents at various points along this dimension. In such cases we may be able to see how close our viewers come to seeing the world as would our hypothetical hermit in solitary confinement with a television set.

The primary tool we have been developing for this purpose, in addition to the portrait sets discussed above, is a semi-projective questionnaire. This instrument incorporates two main types of items. The first type consists of forced error choice items, similar to those used by Hammond*, which require the respondent to select one of two or more answers to a factual question. All of the answers are incorrect, but they are chosen so as to reflect either the bias that is characteristic of television drama, or to represent a bias in a direction opposite to that which would be found on television. In other words, these items require the respondent to choose answers which may reflect either a "television" or a "non-television" (which often means "real world") bias. The second type of item is designed for the same purpose but asks opinion, as opposed to factual, questions on issues that are presented on television in a markedly slanted fashion.

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*Hammond, K. R. "Measuring attitudes by error choice: an indirect method," Journal of Abnormal and Social Psychology, 43:38-48, 1948.

We have assembled an instrument which contains over forty such items, as well as questions about the respondent's age, sex, education, and media habits (daytime and evening television, television news, newspapers, news magazines). This questionnaire was administered by Daniel Starch, Inc./ C. E . Hooper, Inc. in the form of telephone interviews to a probability sample of 607 adult respondents in four metropolitan areas. The sample was prescreened to form two equal groups of light television viewers (less than 2 hours per day) and heavy television viewers (4 hours or more).

The survey was conducted in April, 1973, and we have only partially analysed the results at this point. Some of the clearest patterns we have observed come from the "factual" items in which respondents must choose between answers which represent a television bias and items which represent a non-television bias or a tendency toward reality. One form of analysis consists of comparing the various sections of our sample in terms of the bias-choice patterns. We have calculated the percent "toward TV" choices for the heavy viewers, and for the light viewers. The difference between these percentages we term the "Cultivation Differential" of television viewing for each item.

We have compared the cultivation differentials of several media for a number of "factual" items (see Table 3). Two striking patterns emerge in these comparisons. The cultivation effects of general television viewing show positive and often significant differentials between heavy and light viewers -- with heavy viewers being more likely to choose answers which reflect a "television" bias. As can be seen on Table 3, 11.3 percent more heavy viewers than light viewers overestimate the percentage that Americans are of the world population; that is, in fact what they experience in the world of television. (Sex, age, and education do not significantly affect these margins.) Heavy viewers similarly carry their television experience into the real world of social reality when they give a "television" rather than the very different "real world" answer to questions on population density, employment, crime and violence, and law enforcement. One of the most telling results of exposure to the pattern of victimization seen on television is the fact that heavy viewers significantly overestimate their own chances of encountering violence in real life.

It is interesting to note that the cultivation differentials for heavy and light viewers of television news programs show the same pattern of positive effects. This is particularly striking in view of the second set of comparisons, which show an opposite tendency for heavy vs. light readers and news magazines. (These comparisons are independent of television viewing habits, which are evenly distributed across reading-habit categories.) We find that heavy readers (especially newspaper readers) are consistently, often significantly more likely to choose the non-television biased answer. We feel that this is an important trend which may help to identify the cultivating powers of the various media, and allow us to assess the effects of television in the over-all context of media exposure.

Other comparisons indicate that the viewers of daytime serial programs (who are not all women by any means) show the same cultivation patterns as heavy viewers in general; if anything they show stronger effects. Somewhat more surprising is the fact that education does not seem to predict

TABLE 3: Differences Between Heavy Viewers' and Light Viewers' Conceptions Compared to those of News Readers

QUESTION	CULTIVATION DIFFERENTIALS TV VIEWING HEAVY - LIGHT	TV NEWS VIEWING HEAVY - LIGHT	NEWSPAPERS HEAVY - LIGHT	NEWSMAGS. ANY - NONE
1. US POP. AS % OF WORLD POP. (TV OVEREST.)	+11.3**	+9.2**	-10.9*	-6.7
2. POP. DENSITY OF US VS. OTHER COUNTRIES (TV OVER):	+8.9 **	+3.2	-13.8**	-3.6
3. % WHITE AMER. EMPLOYED AS PROF.& MANAGERS (TV OVER):	+14.4**	+9.4**	-10.7*	-8.5
4. % NONWHITE AMER. EMPLOYED PROF. & MANAGERS (TV OVER):	+ 6.5*	+8.1	- 5.9	+2.3
5. % EMPLOYED AS PRO ATHLETES, ENTERTAINERS, ARTISTS (TV OVER):	+10.2**	+11.0**	-14.4**	-7.1
6. % MALES WITH LAW ENFORCE. JOBS (TV OVERESTIMATES):	+ 9.3*	+12.1**	-18.5**	-1.7
7. % CRIMES THAT ARE VIOLENT (TV OVERESTIMATES):	+ 8.1**	+ 7.4	- 7.2	-11.9**
8. FATAL VIOLENCE OCCURS BET. STRANGERS (TV PATTERN) :	+ 3.4	+ 8.7*	- 2.8	-15.1**
9. % AMERICANS VICTIMS OF VIOLENT CRIME (TV OVER):	+ 1.6	- 0.5	- 8.7*	- 1.8
10. CRIM. CASES DECIDED BY JURY OR JUDGE (TV SAYS JURY):	+ 6.5	+ 8.5*	-17.5**	- 7.0*
11. YOUR CHANCE OF ENCOUNTERING VIOLENCE (TV OVERESTIMATES):	+12.8**	+ 4.6	-12.7*	+ 3.1
12. CONVICTIONS BASED ON EVIDENCE OR TESTIMONY (TV SAYS EVIDENCE):	+ 5.9	+15.1**	- 1.6	- 4.5

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* Differential significant (phi coefficient), p.=.05

** Differential significant (phi coefficient), p.=.01 or better cultivation patterns in any consistant manner. We had supposed that respondents with higher educational levels might be less likely to choose the television-biased answers but, in fact, they seem as likely to do so as those with only high-school or grade-school education. The error choice patterns and cultivation differentials for the questions reflected in Table 3 can be found in Appendix G.

We are also working with an open-ended form of this questionnaire in which the respondent is not given specific choices but is asked to estimate the correct answers to the same questions. On the basis of the limited data we have acquired so far it appears that such answers are fairly comparable to those in the original form, both in absolute magnitude and in cultivation patterns. Firmer conclusions will require more data from samples which include a broader range of respondents than we have so far utilized.

d. Publications

Although only a pilot study, the research built upon previous investigations and provided the basis for several publications and other contributions. The most important are:

"Communications and Social Environment," by George Gerbner (Scientific American, September 1972. See Appendix A)

" Cultural Indicators: the Third Voice," by George Gerbner (Communications Technology and Social Policy, edited by George Gerbner, Larry Gross, and William Melody, Wiley, in press)

" The Reality of Television Fiction: The use of semi-projective techniques for the study of mass-media effects," by Larry Gross and Paul Messaris (presented at the International Communication Association, Montreal, April 1973)

" The Lessons that Television Teaches," by Larry Gross (Today's Education, The Journal of the National Education Association, in press)

Data and methods generated by the project are currently being utilized in the preparation of four Master's theses and three Ph.D. dissertations.

e. Staffing

The professional staff of the project has included:

Dr. George Gerbner, principal investigator, throughout;
Dr. Larry Gross, associate investigator, throughout;
Mr. Micheal F. Eleey, research associate, throughout;
Mr. James P. Murphy, research associate, Jan.1, 1972 to June 30,1972
Ms. Nancy Tedesco, research associate, throughout.

B. SPECIFIC AIMS

1. Annual recording and message system analysis of prime-time and Saturday network television drama will follow methods and procedures developed in the pilot study.

2. Semi-projective picture tests and survey instruments developed in the pilot study will be completed and annually applied to various purposive samples of children and adults. An attempt will be made not only to relate the tests to aspects of the world of television drama but also to indicate changes through repeated testing and panel studies.

3. The comparative dimension of Cultural Indicators will be developed by utilizing existing contacts and arrangements for the parallel conduct of studies by identical methods in other countries to supplement and illuminate the U.S. findings. (Foreign research teams will finance their own studies. The proposed budget is intended to cover only costs of communication and coordination.)

4. Comprehensive Cultural Indicators will combine message system and cultivation measures to present annual, cumulative, and comparative indicators of dominant cultural configurations, common conceptions, and trends relevant to issues of social health and public policy.

C. METHODS OF PROCEDURE

The methodologies employed in the study are those of mass media message system (content) analysis and of cultivation (effects) analysis. The most novel and significant developmental features of both the pilot study and the proposed investigation are the joining of the two methodologies and the formalization of periodic indexing and reporting of the combined results.

1. Message system analysis

Message system analysis is designed to investigate the aggregate and collective premises defining life and its issues in representative samples of mass-produced symbolic material. Such analysis rests on the reliable determination of unambiguously perceived elements of communications. Its data base is not what any individual would select but what an entire national community absorbs. It does not attempt to interpret single or selected units of material, or draw conclusions about artistic merit. The analysis is limited to functions implicit in the prevalence, rate, symbolic structures and distribution of clear and common terms in the samples.*

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*A description of the analytical framework can be found in "Toward Cultural Indicators: The Analysis of Mass Mediated Public Message Systems" by George Gerbner, in The Analysis of Communication Content; Developments in Scientific Theories and Computer Techniques, edited by George Gerbner, et al., New York: John Wiley & Sons, 1969.

The analysis of prime-time and Saturday network television drama will be repeated each year. The principal aspects of this procedure (also noted above in the progress report of the pilot study) are the instrument of analysis, the program samples, the training of analysts, the coding procedure, and the assessment of the reliability of the observations.

* * *

The instrument of analysis was discussed in some detail in the progress report. Its development took account of the comments of the review panel of the pilot project and of the experience of the project itself. The instrument deals with each program as a whole, the cast of major and minor characters, and selected types of action. It facilitates the further development of the "Violence Profile" (see Appendices B, C, D, and F) within the broader context of Cultural Indicators.

The annual monitoring and analysis will include categories used before and others sensitive to new and changing issues of public policy. The history, geography, and demography of the symbolic worlds produced for common vicarious experience and learning will be analyzed. Inter-personal and group relationships portrayed in these message systems will be studied. Themes of nature, science, politics, law, crime, business, education, art, illness and health, peace and war, and sex, love, and friendship, as well as conflict and violence will be observed. Roles, traits, goals, values, and fates of characters engaged in dramatic action will be related to the symbolic worlds in which they act and to the issues with which they grapple.

The annual solid-week sample, recorded in the fall of each new season, consists of approximately 100 programs (70 hours), 300 major and 500 minor characters, and 500 specific acts or episodes of a specified nature. All programs in the sample are videotaped for analysis and coding, and remain in the cumulative archives of the project for further study. The solid week sample has been demonstrated to be at least as generalizable to a year's programming as larger randomly selected samples.*

Coders using the instrument of analysis are trained in observation of a specialized kind. They must make reliable discriminations called for in the instrument and record these in a specified form. They focus on what is presented in the material and not how it might be judged by a critical viewer. Their task is to generate the data for the subsequent analysis and interpretation of common message elements and structures available to a public of diverse viewers.

The training consists of individual and paired use of the instrument of analysis on taped television programs made available for that purpose. The coding of each item is discussed, and problems of definition and interpretation are uniformly resolved. The results of training analyses are subjected to a special procedure which permits the identification of deviant observers, and estimates the extent to which such an observer is corrigible by further instruction.*

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*Michael F. Eleey, "Variations in Generalizability Resulting from Sampling Characteristics of Content Analysis Data: A Case Study." The Annenberg School of Communications, University of Pennsylvania, 1969.

This procedure leads to the screening and final selection of coders for the staff. All analysis is done by monitoring the taped programs as many times as necessary, and playing back selected portions on playback machines available for that purpose.

Reliability measures are designed to ascertain the degree to which the recorded data truly reflect the properties of the material being studied and not the contamination of observer bias or of instrument ambiguity. Theoretically both types of contamination are correctable, either by refining the instrument or intensifying coder training, or as a last resort, by eliminating the unsalvageable variable or dismissing the incorrigible coder. Measures of reliability thus serve two functions: as diagnostic tools in the confirmation of the recording process, and as final evaluators of the accuracy of the phenomena's representations in the actual recorded data.

Four computational formulae are currently available for calculating the coefficient of agreement. These variations are distinguished by a difference function, the form of which depends upon the scale type of the particular variable being analyzed. Except for their respective scale-appropriate sensitivity to deviations from perfect agreement, all formulae make the same basic assumptions as the prototype for nominal scales devised by Scott.** Thus, in the case of the binary variable, all four formulae yield identical results.***

The reliability of the analysis is thus achieved by multiple codings, and the measured agreement of trained analysts on each usable item. If one were to substitute the perceptions and impressions of casual observers, no matter how sophisticated, the value of the investigation would be reduced, and its purpose confounded. Only an objective analysis of unambiguous message elements, and their separation from personal impressions left by unidentified clues, can provide the basis for comparison with audience perceptions, conceptions, and behavior.

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*Klaus Krippendorff, "Estimating the Reliability, Systematic Error and Random Error of Interval Data." Educational and Psychological Measurement 30:61-70, spring, 1970.

**William A. Scott, "Reliability of Content Analysis: The Case of Nominal Scale Coding," Public Opinion Quarterly 17:3:321-325, 1955.

***For the derivation of the formulae and discussion of their properties, see Klaus Krippendorff, "A Computer Program for Analyzing Multivariate Agreements, Version 2," Mimeo, Philadelphia: University of Pennsylvania, The Annenberg School of Communications, March 1970. By the same author, "A Family of Bivariate Agreement Coefficients for the Reliability of Data," Mimeo, Philadelphia: University of Pennsylvania, The Annenberg School of Communications, 1968.

2. Cultivation analysis

The progress report of the pilot project has already accounted for the use of semi-projective picture tests and survey instruments developed in preparation for the main stage of the cultivation analysis. Here we shall note the more theoretical aspects of our methodological approach.

Cultivation analysis begins with the patterns found in the "world" of television drama. The common message systems composing that world present a coherent image of life and society. How is this image reflected in the images, expectations, definitions, interpretations and values held by its audiences? Do people see the world as TV shows it? In some cases, the old West for example, most people know little else but what they see on TV and in the movies. How are the "lessons" of symbolic behavior derived from other times and places, and presented in synthetic, fictional contexts, applied to assumptions about real life? Clearly, the impact of the television world on the real world of the viewers is subtle and complex. Klapper's comprehensive survey* noted the paucity of investigation in this area. One major U.S. investigation involving children, reported in 1961,** was limited to small community surveys and was not related to symbolic functions of television program content. The more varied and often more sophisticated studies conducted for the Surgeon General's Scientific Advisory Committee on Television and Social Behavior*** were similarly in no position to base their investigation of presumed media effects upon a careful and systematic study of media portrayals. Therefore, in order to improve procedures for the investigation of the cultivation effects of the actual message systems to which large viewing publics (and, indirectly, the entire community) are exposed, it was necessary to utilize an extensive data base and to develop new tools and techniques. That is what the pilot project (reported above) has done.

The principal approaches employed in the cultivation analysis will continue to be semi-projective techniques and periodic questions on national probability sample surveys. Regional child panels would provide the subjects for additional projective and interview work.

The central methodological tool we are using in our examination of the images of reality which may be cultivated by television drama is the semi-projective procedure. Projective tests are most commonly used by clinical psychologists who wish to

> . . . approach the personality and induce the individual to reveal his way of organizing experience by giving him a field

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*The Effects of Mass Communications by Joseph T. Klapper. The Free Press, 1960. See e.g. p. 251.

**Television in the Lives of Our Children by Wilbur Schramm, Jack Lyle, and Edwin B. Parker. Stanford University Press, 1961.

***Television and Social Behavior edited by G. A. Comstock and E. A. Rubinstein, Volumes 1 to 5. Washington: Government Printing Office, 1972.

The other major approach will be the survey method as developed in the pilot study. Questions selected from the projective and interview techniques, and others designed especially for survey use, will be submitted annually to a national adult probability sample of respondents. The responses will yield indications of the dynamics of cultivation, and will also be useful in comparisons with responses yielded by the other methods.

Are audiences aware of the distortion, both explicit and implicit, in television's world? Will viewers reproduce the TV "line" when asked to describe, evaluate, predict or analyze events in the real world? Here the "error-choice" technique will be utilized. A person must choose between two answers to certain questions (e.g., What percentage of murders are committed by women? By relatives? Are solved by police?), each of which is incorrect -- one exaggerating and one minimizing some aspect of a situation. Acceptance of the television drama image might be expected to lead to an underestimation of the proportion of female murderers, and underestimation of the number of murders committed by relatives, and an overestimation of the percentage of homicides solved by the police.

Further, will viewers distinguish between the reality of TV drama and that of news? Can they see, and will they report differences? How are the controversial issues -- war, crime, drugs, youthful unrest, sex roles -- reflected via TV drama and news in the minds of audiences? How accurate is the public knowledge of the facts, and how close their definitions to those offered explicitly and implicitly on television? How consistent and how homogeneous are these conceptions? Regardless of their direction and nature, are the responses of heavy viewers more alike than those of non-viewers? Does television create a range or a consensus of knowledge, or of ignorance? Does a homogeneity of response, if it exists, extend to issues unrelated to television drama and its immediate impact?

The results of the pilot study (reported above) demonstrate the feasibility and usefulness of this approach for the specific assessment of the contributions television makes to the cultivation of public images of social reality.

The final methodological aspect of the proposed study will be the development of comprehensive indices, and the establishment of computer and reporting techniques for the periodic summarization and presentation of cumulative and comparative findings.

D. SIGNIFICANCE

Culture is that system of messages which cultivates patterns of shared images and, therefore, of social behavior, relationships, and interactions. Acculturation is that critical aspect of socialization which denotes the development of stable images of self and the world, and of how to behave in one's world. The dominant communication agencies produce message systems that cultivate the broadest common notions of what is, what is important, and what is right. They structure the public agenda of existence, priorities, and values. People use this agenda -- some more selectively than others -- to support their ideas and actions. Any significant change in the technology, ownership, clientele, outlook, or other institutional characteristics of dominant communication agencies may alter the patterns.

In a folk culture, the production of traditional symbols and figures (representations of gods, chiefs, demons, animals, and men), the conduct of rituals, and the spinning of tales inspire awe and strike terror, as needed, to control the "growing up" process. In mass cultures, institutional policies and manufactured symbolic commodities cultivate norms of conduct.

Mass communication is the extension of institutionalized public acculturation beyond the limits of face-to-face and any other personally mediated interaction. This becomes possible when technological means are available and social organizations emerge for the mass production and distribution of messages. Mass media are such technological means and social organizations, with television being the most broadly shared and ubiquitous of American mass media.

A long series of private and government commissions, Congressional committees, and foundation-supported studies have, since the early 1930'ies, called for some sort of media surveillance. But none of these proposals spelled out how that might be done, or limited the scope to manageable proportions clearly relevant to scientific purpose and public policy. And, at any rate, none of them was implemented.

Our prior studies, supported by the National Science Foundation, the Surgeon General's Scientific Advisory Committee on Television and Social Behavior, the National Institute of Mental Health, and other agencies, have established the basis for and have demonstrated the feasibility of this project. Social scientists, legislators, and government agencies have called for the development of indicators and profiles of cultural trends relevant to salient issues of social health and national policy, and conducted in a broad and sophisticated framework.

We need to know general trends in the cultivation of assumptions about problems of existence, priorities, values, and relationships before we can validly interpret specific relevant policies or facts of individual and social response. Interpretations of public opinion (i.e. published responses to questions elicited in specific cultural contexts), and of many media and other cultural policy matters, require cultural indicators similar to the accounts compiled to guide economic decisions and to other indicators proposed to inform social policy-making.

The most general significance of cultural indicators will be, therefore, that of a systematic and reliable surveillance of mass-cultural configurations and of their symbolic functions. A more specific area of significance will be the testing of a theory of symbolic functions which contends that mass-distributed (televised) dramatic entertainment provides common and ritualistic demonstrations of social relationships, powers, and values, and, furthermore, that these symbolic functions cultivate the most pervasive public conceptions of social reality.

APPENDIX E

REPRESENTATIVE SECONDARY HYPOTHESES

The following are representative of the secondary hypotheses to be examined during the study. The NIE reader is invited to browse through this "shopping list" and request emphasis of some hypotheses and deletion of others, etc. Most important, we hope this list will provoke further joint PCI/NIE formulations.

ATLANTIC RESEARCH CORPORATION AND THE UNIVERSITY OF KENTUCKY

Because of the manner of implementation, there will be enormous institutional change. The University of Kentucky, as an underdog for this activity, is using it to enlarge its reputation and share of the higher education market, in full cooperation with the ARC, which has set clear and coherent objectives. We've injected a note of competition into what are not conventionally competitive markets - higher education, telecommunications, and education. Frankly, one expects to see the least changes in the latter - education per se, because the University of Kentucky product in no way differs from the standard* other than by the means of distribution.

The range of hypotheses that really are McLuhanesque - the medium is the message - should not be a strong factor in this environment, as we are in no way reaching people who are unacquainted with TV, and we are reaching adults in every case. However, we might find a different kind of McLuhanesque effect in that the experiment may be the message - the University of Kentucky is likely to be wiring up these trainees somewhat like laboratory animals.

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* Dave Irving suggests it will be substandard.

HYPOTHESIS ONE

The things that the ATS-F can do, and are programmed to do, will be duplicated by other more conventional mechanisms and agencies. This dynamic can be variously characterized as a free market phenomenon, an innovation dissemination process by which the first innovator proves that something can be done and thereby sparks a series of emulators, etc. The issue is in any event clear. As the ATS-F can provide a mass distribution mechanism for audio-video communications, we will expect to see (and there are in fact already indications of) local educational TV stations, school districts, and conventional telecommunications (e.g., telephone system) resolving their various jurisdictional disputes and complicated (but not difficult) telecommunications, jurisdictional, and logistics problems to provide comparable services.

HYPOTHESIS TWO

The association of the University of Kentucky with this experiment will enhance its image among the educational administrators and providers of service.

HYPOTHESIS THREE

The beneficial effects on the University of Kentucky's image will not be entirely dependent upon the success or failure of this experiment in educational terms. The increased visibility of the University and its association with this high technology activity will in and of itself create this effect. We would expect to see this effect in educational administrators' responses to such relatively non-reactive questions as "to what universities would you most likely turn for assistance regarding topics of the following kind?" and such rather more direct queries as "please rank the following universities in order of preference regarding their value as institutions for teacher training and/or general education: Pennsylvania State, Ohio State, University of Kentucky, Georgia State, etc."

HYPOTHESIS FOUR

The creation of deadlines and the spirit of competition, etc., introduced to this program will increase the University of Kentucky productivity in developing courses. We expect to see this both in the short term in the sense that the manhours spent in program development per se will be less than normally spent to develop courses of the same effectiveness, nad in the long term we would expect there to be some residual impact by which other larger educational programs tend to move towards this higher productivity standard.

The beneficial impact of task orientation, etc., resulting from the University of Kentucky team's need to meet deadlines, both externally imposed by the bureaucracy and grantors, and more importantly (externally) imposed by the demands of satellite availability, will generally improve the University of Kentucky's management orientation and we can expect to see some change in the way the University of Kentucky organizes to meet comparable types of objectives.

HYPOTHESIS FIVE

The University of Kentucky task orientation will cause it to outreach to experts, ideas, and individuals not normally considered in the development of similar programs. Hence, we would expect to see - at least in the second generation (revised) curriculum - some innovation in program content and/or delivery that goes beyond simply applying the technology itself. (We expect this effect to vary with the degree to which the sense of immediacy of the program as well as its extensiveness, result in extensive and intensive feedback regarding value.)

HYPOTHESIS SIX

The implicit hypothesis in the preceeding, is that this massive relatively immediate distribution, will provide the University of Kentucky feedback of an extent and type not normal to educators.

HYPOTHESIS SEVEN

The nature of that feedback will be (appropriately) determined by the ARC and its cooperating local RESA's - hence, the value of such institutionalized yet flexible feedback mechanisms must be judged independently of the value of the program changes effected via such feedback.

HYPOTHESIS EIGHT

The RESA's ability to effect and actually impact on local colleges will be improved, as a direct function of the level of involvement of the participating faculty members.

HYPOTHESIS NINE

The quality of education available at and/or the number of community colleges will be negatively affected.

HYPOTHESIS TEN

The five "cooperating faculty members" will have their status relative to their peers increased.

HYPOTHESIS ELEVEN

Quite generally, the success pattern for faculty will be modified so that there will be more "Brownie" points for involvement with comparable telecommunications activities.

HYPOTHESIS TWELVE

The degree of stated Board of Education's cooperation in making micro fiche available in support of these problems will be an indicator of their relative support.

HYPOTHESIS THIRTEEN

The greatest learning will be experienced in the four-channel audio sections.

HYPOTHESIS FOURTEEN

Both learning and perceived value of the TV experiment will be a function of the degree and nature of prior exposure to TV activities. (It is expected that these may vary differently - the former directly and the latter inversely.)

HYPOTHESIS FIFTEEN

This experiment will make highly visible the process by which local action groups and activities are destroyed by centralized authorities without premeditation or malice. Specifically, the success of programs of this type depend largely upon the ability of such local personnel as the site coordinators, to convince the general populace of the value of this program. It is inevitable however, that the rules of the game get changed by the central authority - making the local official appear a "liar" or at least ineffectual. What we have then is a natural transference from allegiance to local representatives to necessary interaction and reliance upon the central authority.

By analogy we would expect this dynamic to transfer the allegiance of the local populations from local principals, faculty, and school boards, to the centralized state authorities.

HYPOTHESIS SIXTEEN

One effect of such unprecedented demonstrations (that is, demonstrations of things that have never been done before) will be to inspire (creative) task-oriented thinking. Individuals and organizations will step out of the established way of doing things, and in some cases will find that they have conspired to violate the intent of law as well as precedent. (In the former regard, we have to connivance of the University of Kentucky, which is going to counter legislative intent by not charging tuition for courses broadcast over the network. With regard to the latter, we have the sudden ability of the public service TV networks to patch themselves together to form a regional net.)

HYPOTHESIS SEVENTEEN

The institutions that are receiving federal money to support this demonstration, will tend to create an artificial dependence on the technology. (We consider the dependence artificial, if and only if, it is not the most cost effective way of achieving the primary mission - e.g., education.) We expect to find it "impractical" or "impossible" to deliver certain types of instructions by means other than the satellite, in spite of what objective cost-benefit analysis might reveal.

HYPOTHESIS EIGHTEEN

This institutionalization will go so far that a spurious body of knowledge will be developed, so that others may be trained in use of this technology. Will we move from having schools of education to train educators, to schools to train educators who train educators, to the further step of vocational schools to train educators to train educators in how to train educators to use this technology?

HYPOTHESIS NINETEEN

There will be a point at which the ATS of demonstrations comparable to it will be sufficiently intrusive, that the conventional delivery mechanisms and rational bureaucratic interests of states and local institutions will be sufficient to stop further demonstrations. It is not clear, however, that this point will be reached before operational status is achieved.

HYPOTHESIS TWENTY

The NIE views the ATS-F educational ESCD as an educational experiment. It is concerned that other activities for agencies may inadvertently intrude upon the experimental nature of this activity, thereby reducing its research value. It is not comparably concerned with the fact that there are other federal experiments being impacted by the ATS-F -- for example, one may consider the concept of the Appalachian Regional Commission or of the Federation of Rocky Mountain States as experiments themselves. Given this lack of coordination and awareness among these different federal experimental and demonstration prespectives, it is impractical for the Federal Government to view these as experiments, except on the federal level itself.

HYPOTHESIS TWENTY-ONE

The medium is the message.

HYPOTHESIS TWENTY-TWO

The value of mass communication demonstrations is limited to multi-state areas, as the essential value is in the degree to which the technology can overcome normal bureaucratic resistance to multi-state programs.

HYPOTHESIS TWENTY-THREE

Both the glamour, as well as the service provided by this operation, will importantly support and make more effective the existing coordinating mechanisms (e.g., RESA's, the ARC, etc.)

HYPOTHESIS TWENTY-FOUR

The glamour will be more important than the service.

HYPOTHESIS TWENTY-FIVE

The degree to which this experiment succeeds in effecting important change, will vary with the competence and interest of the site coordinators at the local RESA's, and the relative effectiveness of those site coordinators.

HYPOTHESIS TWENTY-SIX

The instrusion of the ATS technology will result in the use and support of other technologies of more direct relevance to educational needs (e.g., the four channel pad.)

HYPOTHESIS TWENTY-SEVEN

The implicit objective of the university contractors will be homogenization as that term has been used, with a specific emphasis on insuring that trainees "adopt the attitudes we want them to have."

The net long term affect of this type of activity will be that the teachers and other adults reached by the network, will be plugged into an interactive conditioning network, such that this small beginning will simply accelerate an inevitable trend.

HYPOTHESIS TWENTY-EIGHT

Generally the most profound effect of this experiment would be a continued over investment in technology rather than substance, in telecommunications rather than program content, etc.

HYPOTHESIS TWENTY-NINE

The availability of federal funds for demonstration will inevitably result in such demonstrations, regardless of the chosen intermediaries. That is, there will always be somebody who will value zero cost activity. The set of somebodies who do so value it will ultimately persuade agencies to in fact undertake such a demonstration. (A good example of this has already occurred in the ARC, which, originally, considered this a foolish idea, and finally succumbed to a "grass roots' level of interest.)

HYPOTHESIS THIRTY

The availability of this communication mechanism will cause public TV networks to provide comparable types of services - through conventional patching of telecommunications links, etc.

HYPOTHESIS THIRTY-ONE

The regional availability of standard programs will effect the nature and extent of competitive programs available. The nature of that effect will be such that it may either increase programs of a comparable nature at local and/or through alternative regional mechanisms, or decrease it. An important experimental question to be addressed by the evaluation is what the other independent variables are. That is, under what conditions will the availability of standard regionalized programming result in increased competition for the same type of services (that is, community colleges and other local agencies, etc.) entering the same market with renewed vigor, and in what conditions will it cause local programs of comparable nature to atrophy.

We expect within the Appalachian Region to find both extremes. Within the area affected directly by the network, we would expect to find a diminished emphasis on alternative mechanisms of teacher education. In the areas immediately outside the network, we may well find an increased attention to teacher education, particularly by the community colleges.

HYPOTHESIS THIRTY-TWO

The social value of the programs displaced by the satellite demonstration programs, will exceed the social value of the programs actually broadcast via the demonstration. This will be an important cost of such demonstrations.

HYPOTHESIS THIRTY-THREE

The availability of this technology will justify quite generally the continuation of marginal institutions. Particularly, where such marginality relates to cost effectiveness in a relatively free market.

HYPOTHESIS THIRTY-FOUR

Putting together the above hypotheses in a hypothesis regarding the tendency for these programs to continue, the net long term impact of continuing regional demonstrations will be to institutionalize and perpetuate the marginal institutions to the point where they will control the market.

HYPOTHESIS THIRTY-FIVE

By extension of the above hypothesis and our earlier hypothesis regarding the homogenization of material, and the nature of institutional feedback, the total long term effect will be to institutionalize the practices of what were prior to the demonstration, marginal institutions. This can be viewed alternatively as a step toward innovation or toward mediocrity.

HYPOTHESIS THIRTY-SIX

The nature of jurisdictional issues regarding application of this technology will be observable in the nature and extent of requests by state governments and possibly other agencies or consumer groups for federal standards for satellite transmission.

HYPOTHESIS THIRTY-SEVEN

It will be in the long term interest of the Federal Government to continue programs of this type on a strictly experimental and demonstration basis, if for no other reason than to delay the development of federal standards until such time as federal objectives have been clarified.

HYPOTHESIS THIRTY-EIGHT

The original ARC request for proposal required the broadcasting of 100 hours of television broadcasting and career education and reading, with specification of data basis. The negotiated price of the contract with the University of Kentucky, was slightly above one million dollars, implying a unit cost per half-hour program of $5,000. This cost implies high efficiency on the part of the University of Kentucky. It is symptomatic of the federal problem in dealing with its various experiments (e.g., the ARC experiment vs. the TV experiment) that NIE subsequently increased budget for the UNiversity of Kentucky activity by half-a-million dollars, thus diminishing ARC's emphasis on cost minimization and ARC's real control over UK.

HYPOTHESIS THIRTY-NINE

The above dynamic by which NIE undercits ARC's management perogatives, is another example of the inadvertant manner by which centralized activities destroy local organizations and relationships.

HYPOTHESIS FORTY

The mass dissemination of this type of program material will result in a significant increase in the number of audiences that provide feedback regarding that program.

HYPOTHESIS FORTY-ONE

An unobstrusive indicator of effect of demand and reception of the program and/or of perceived value of the programs will be whether or not the local receiving groups buy new televisions and/or the time it takes them to buy such receivers.

HYPOTHESIS FORTY-TWO

The quality of the TV receiver will be of more importance than the quality of the satellite link.

APPENDIX F.

VERMONT/NEW HAMPSHIRE INTERACTIVE TELEVISION HYPOTHESES TO BE TESTED IN ESCD:

- For formal education programs, television is as effective as comparable classroom instruction.

- The broadcasters do not have clear continuing education objectives nor do they have an accurate picture of the needs of the rural TV users. (This lack of awareness may be changed by ESCD)

- The system may be of high value in promoting "best practice" by (a) affirming local education judgements, and (b) encouraging the adoption of new practices already known to the rural community.

- The amount of time spent viewing satellite TV programs is subtractive from the total hours spent on education.

- "The main advantage of this kind of medium is to polish one's approach to specific types of problems."

- Although the data are by no means conclusive, they suggest that satellite TV could be an important factor in helping remote practitioners translate knowledge into practice. Respondents seemed receptive to using TV discussions and demonstrations as the final cause in behavior changes that may have been suggested by other media (e.g., the journals). If satellite TV does reduce the delay between knowledge and practice, and provides prompt feedback relative to the changed behavior, it will have addressed a problem perceived by broadcasters as key.

- Interaction does not appear to be a critical factor in achieving utilization of knowledge resulting from television viewing.

- The costs of improving education, or of simply conveying knowledge, using the satellite TV are high compared with feasible alternatives.

- The presence of the system has encouraged the development of new continuing education programs.
- However, only a limited number of these new educational programs appear to be experimental in the sense of defining innovative approaches to learning.
- Aside from TV participation, there is little change in the pattern of interaction between the broadcaster and the TV user.
- There are changes apparent in the interaction patterns within the TV viewing community.
- There are no apparent changes in interaction patterns within the broadcasting community -- however, some individuals are changing their views and approach to the problems of the TV viewing audience.
- The relationship between broadcasters using the same system improves as a result of the television.

MEMORANDUM

To: Larry Posner, Leon Rosenberg
From: Roger Coates
Subject: PCI and the Indian ATS-F Experiment

SUMMARY

Indian institutions responsible for the ATS-F educational satellite experiment (SITE) are currently developing both the technical and the social (impact) evaluation designs for the FY 77 experiment. Indian officials of the Indian Space Research Organization (ISRO) are participating actively in the technical aspects of the U.S. experiment; they appear to be moderately interested in establishing a dialogue with U.S. organizations about the social impact of the U.S./Indian experiments.

FACTS AND OPINIONS

1. The Indian organization assuming the lead in SITE is the ISRO. This organization has established a software research and evaluation group at the Space Applications Center of ISRO in Ahmenabad, India, which is currently conducting a number of activities in preparation for SITE. Of most immediate concern to PCI, this group is:

   - Developing several agricultural programs and field testing them via broadcast TV for audience impact.
   - Beginning to develop recommmendations for programming for the All-India Radio (AIR), a government institution that will be responsible for SITE programming in FY 77, on the basis of these tests.
   - Developing evaluation designs for both the "technical" and "social"

aspects of SITE (this evaluation plan should be complete "in about a month").

2. The matters that appear to be of major concern to Indians (per ISRO) at this time are technical ones. ISRO is bringing Indian-produced receivers here to the U.S. to test them during FY 75, and Indian engineers/scientists are detailed to Goddard Space Center and NASA to observe the production of satellite hardware, the preparation for launch, and other such processes. The several Indians with whom I spoke differentiate between the two types of evaluation and feel that the differences in intended programming in the two countries ("education" in U.S.; agriculture, family planning and rural development in India) and the differing cultural contexts preclude close collaboration in evaluation design. "Indian conditions are just too different." I have not, however, spoken with those designing the evaluations.

3. There are actually three cells in the software research and evaluation group of ISRO: Research and Evaluation, Coordination, and Production. The coordination group is considered by Richard Barnes of NASA to have significant need for assistance in "putting it all together." Harvard Business School has been assisting the Indian Institute of Management (also of Ahmenabad) in assisting ISRO: "There are still many problems to be solved." To give perspective on the extent of this group's task, the Indian responsibilities for the joint U.S.-India SITE are:

   - Development and pre-testing of potential programs (ISRO).
   - Planning and coordination of all Indian government agencies concerned with SITE. (ISRO, DAE, Ministries of Agriculture, Health, Education, Family Planning)

- Securing of international frequency clearances.
- Development of programming for transmission (AIR).
- Evaluation of experiment.
- Assumption of all non-satellite system costs.

RESOURCE PEOPLE (in order of decreasing probable value)

1. Dr. Agarwal, Chief, Research and Evaluation Group, ISRO
   (address, ISRO organization chart coming by mail)
   [evaluation design, PMI Seminar]

2. Mr. Richard Barnes, Director of International Programs, NASA
   (755-3883)
   [contact to responsible Indians]

3. Dr. William Williams, U.S. Embassy Science Attachee, New Delhi
   [contact to responsible Indians]

4. Mr. R.G. Pillai, ISRO representative, Goddard Space Center, Greenbelt, Md.
   (301-982-2880; sending info in 1. above; would welcome visit to PCI later on in April")
   ["window" to ISRO; knowledge of SITE technical information; contacts with ISRO officials]

5. Mr. Pradu Ghate, Indian Embassy, Washington, D.C.
   (CO5-5050)
   [contact to responsible Indians; cheap cable to India!]

6. Dr. Samuel Paul, Dean of Indian Institute of Management, Ahmenabad, India
   [possible insights in Indian system management, evaluation needs]

RECOMMENDATIONS

1. Contact Mr. Pillai after his ISRO information arrives.
2. Contact Dr. Agarwal for NIE information, PMI Seminar participation. (probably not panel)
3. Develop close collaborative relationship with Mr. Barnes of NASA.

APPENDIX H: BROCHURES: ECON, INCORPORATED; EDUCATION TURNKEY SYSTEMS.

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- State of Michigan COST-ED Simulation - The economics of alternative instructional delivery systems for elementary reading programs were simulated under various projected inflationary possibilities.
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EDUCATION TURNKEY SYSTEMS, INC.
1660 L STREET, N. W.,
WASHINGTON, D. C. 20036

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EDUCATION TURNKEY SYSTEMS, INC. and its staff of nationally-known educators and managers are irrevocably committed to educational reform and responsible innovation through the introduction of sound management practices for State and Local Education Agencies. As our name implies, our goal is to put ourselves out of business by "turnkeying" these capabilities over to our clients, when our work is complete.

APPENDIX I

OPTIONAL INTENSIVE ANALYSIS OF FOUR ALASKAN VILLAGES

Not included in the previous sections is an optional "intensive analysis of four Alaskan villages" which will be submitted one week after submission of this report.

PCI has requested expert counsel on its plans for evaluation in Alaskan native villages from Mr. Adrian Parmeter who has conducted field investigations in Alaska as Staff Director of the Senate Subcommittee on Indian Education (1968-1969), and has also served as Director of the Alaska Federation of Natives Land Claims Lobby.

Mr. Parmeter feels that it is feasible and desireable to use Alaskan institutions to train native villagers in four representative villages (Aniak, NIkolai, Ft. Yukon, and Angoon) to generate high quality data for analysis.

Kenneth Hicks
Staff System Scientist

Education:

1950 B.Sc. (Honours) University of Manchester, U.K.
Applied Mathematics

1949 B.Sc. (Honours) University of Manchester, U.K.
Physics and Mathematical Statistics

Experience:

Prior to joining ECON, Inc., Mr. Hicks had extensive experience in systems science research, advanced systems planning, systems development, systems support and systems engineering applied to large scale future military systems, commercial systems and business capture development planning. As a consequence he has applications knowledge and interest in systems structure and evaluation processes and measures, as well as being conversant with many pertinent technologies, operating techniques, organizational influences and constraints and technological forecasting.

Recently, for NASA, Mr. Hicks investigated the problem of the development of a national domestic integrated communication system for the 1980's including networking needs for education and the alternative technologies for locating these networks. He has additionally studied the coupling between technological development and econometrics for domestic communications and the influences on communication service pricing.

Earlier in his career, Mr. Hicks performed research in electro-optics, optics, communications, airborne collision avoidance, integrated logistic support, radio astronomy, navigation and the influence of nuclear weapon effects on systems, flight simulations and aircraft stress analysis.

These research investigations included psychophysical and technological requirements for target detection and recognition of military targets using low light level TV and the use of a TV system for weapon guidance.

Mr. Hicks is the author of many publications and reports relating to his research and systems investigations.

Joel S. Greenberg
Associate

Education:

1960	M.E.E., Syracuse University
1952	B.E.E., Polytechnic Institute of Brooklyn

Experience:

Mr. Greenberg is a specialist in systems analysis and long range planning. He is currently a member of the Aerospace and Mechanical Sciences Department of Princeton University where he is responsible for research in the areas of economic and risk analysis of space systems. He is currently engaged in an economic analysis of standardized spacecraft alaternatives for the Atomic Energy Commission and with the NASA Office of Planetary Programs in a research program to develop a methodology for an economic analysis of solar system exploration space missions. Mr. Greenberg has developed methodologies and techniques for the planning and economic evaluation of space systems and missions which explicitly consider reliability, uncertainty and risk.

Mr. Greenberg has been an advisor to business and government in the areas of benefit-cost analysis, acquisition analysis, risk analysis, and business and R & D program evaluation and planning. He has recently participatedl in the studies of the economic assessment of the Space Shuttle and advanced space propulsion systems and was responsible for their reliability, uncertainty and risk analyses.

Mr. Greenberg was a senior member of the RCA Corporate Staff Operations Research Group and was responsible for applying operations research techniques to the evaluation and planning of new business ventures. He developed corporate planning and risk analysis models and was instrumental in getting corporate management to utilize risk analysis techniques on a routine basis. Mr. Greenberg also performed new business studies for the corporation.

In addition to his background in cost and economic analysis, Mr. Greenberg has had considerable experience in communication systems and Space Communication Systems analysis and communications technology research and development.

Mr. Greenberg is the author of numerous papers and the owner of rights to two patents. He is a regular guest lecturer for the American Management Association lecturing on risk analysis and R & D program planning and evaluation.

Vladimir A. Masch
Director, Mathematical Economic Planning

Education:

1971 Doctor of Economics in Mathematical Economics, Central Economic-Mathematical Institute of the Academy of Sciences of the USSR, Moscow

1963 Ph.D., Moscow State University

Experience:

Dr. Vladimir A. Masch has unique experience and knowledge in the use of information technology in planning. He worked in this field in the U.S.S.R. for 12 years, mainly as Chief of the Laboratory for Optimal Location of Industry, in the Central Economic-Mathematical Institute of the Academy of Sciences of the U.S.S.R., Moscow (9 years). For 6 years, he was vice-chairman of the Joint Academy-Gosplan Committee responsible for the "Methodology of Using Economic-Mathematical Methods in Long-Term Planning of Development and Location of Industry".

He was chief of several projects for computer solution of problems on location and development planning in different branches of industry in the U.S.S.R., including: the coke coal industry (from coal mines and pits to enrichment factories to coke plants and to use of coke in metallurgy); fertilizers industry; production of home refrigerators; branch industry cluster "agriculture - feed processing - evaluation of consumers' demand", etc.

Dr. Masch also devised several highly efficient mathematical programming and simulation algorithms. He has 39 publications, including three in the U.S.A. Since 1968, he has been working on problems connected with the necessity of subjective participation in the decision-making process including: (a) Analysis of considerations requiring such a participation and of modern approaches to subjective decision-making in complex problems; (b) Discovery and arranging into a coherent system the interrelated consequences of the subjective nature of decision-making, in such fields as economics, political science, etc.; and (c) Development of mathematical programming and simulation models, and related algorithms, consistent with and/or adjunct to subjective decision-making.

John P. Skratt
Manager, West Coast Office
ECON, Inc.

Education:

1967	M.B.A., Santa Clara University, Business Administration
1960	B.S., Northrop Institute of Technology, Aeronautical Engineering

Experience:

Since joining ECON, Mr. Skratt has participated in the development and presentation of a series of courses teaching government personnel methods for establishing economic considerations of R&D projects and evaluations.

Previously, Mr. Skratt tested prototype hardware development and design for high speed aircraft ejection capsules. He is fully experienced in hardware design, fabrication processes, and structural analysis and test procedures. He has directed engineers in the study of advanced spacecraft and launch vehicle performance including feasibility studies of performance evaluation, system sizing and operations modeling, trajectory simulation, error analysis and orbit mechanics. For Navy and Air Force programs, he has formulated a methodology appropriate to defining effectiveness envelopes for advanced space system concepts.

He was task leader in a study to evaluate performance and to analyze multidiscipline systems required to evaluate the relative cost, benefit, and effectiveness of current and advanced space tug vehicles.

Other work dealing with advanced design space systems included the development of a multidiscipline analytical approach for effectively applying systems analysis concepts to the evaluation of a potential market for advanced design space systems. He has also provided launch vehicle performance characteristics for advanced mission applications through determining individual user requirements, coordinating data generation tasks and presenting results.

Robert J. Christie
Vice President
ECON, Inc.

Education:

1965	Ph.D. (in process), New York University, Operations Research
1965	M.S., Rutgers University, Statistics
1961	B.S., Brooklyn College, Mathematics

Experience:

Mr. Christie has broad and extensive experience in cost-effectiveness analyses, statistical studies and operations research. He has directed and participated in cost-effectiveness studies in both the military and aerospace areas. These studies included an analysis of the cost-effectiveness of alternative fuzing systems for a new mortar under development by the U.S. Army and an economic analysis of alternative propulsion systems for NASA and DOD space missions in the 1980s.

He developed the sample design and data analysis procedures for a number of sample surveys relating to a variety of governmental areas including federal social programs, federal library files, state population surveys and state education surveys. In each instance, the statistical analysis performed required the application of complex probability sampling (non-simple random sampling) utilizing known information concerning the composition and structure of the target population.

Mr. Christie has directed and participated in studies to identify and control the cost, schedule and performance risks associated with the development programs of major weapon systems. He has participated in studies involving the identification of economically optimum plant site locations and managed a project that identified economically optimal truck routes from existing and proposed new warehouse sites to more than a hundred "stops" scattered throughout New Jersey. He recently coauthored with Dr. L.D. Maxi a text in Test to Failure Methodology which surveys existing data analysis techniques and proposes new statistical procedures for the design and analysis of quantal response test data.

He has taught educational programs in System Safety Analysis, Modern Analytic Techniques for Decision Making, Systems Analysis, System Reliability and Risk Analysis for clients including the U.S. Army Electronics Command and the Army Material Command.

Edward J. Greenblat
Director, Technology Economics
ECON, Inc.

Education:

1972 Ph.D., New York University, Economics

1960 B.S., New York University, Economics

1955-57 Rensselaer Polytechnic Institute

Experience:

Dr. Greenblat has experience in establishing the economic implications and applications of satellites and emerging technologies and policy. For NASA he recently managed a project to evaluate U.S. policy in exporting advanced technology.

His work with satellite technology and policy includes: the analysis of the economic benefits of Earth Resources Observations Satellites applications to water resources management in southern Florida; the development of a methodology for the economic analysis of contributions by remote sensing satellite systems to earth resources management; the formulation of case studies in grazing land management and environmental control systems for analysis of space applications; an analysis of the economic benefits that less developed countries might derive from using Earth Resources Technology Satellite imagery; and cost-benefit analysis of an Earth Resources Observation Satellite application to estuarine and coastal management.

Dr. Greenblat participated in the economic analysis of the space shuttle and managed an economic analysis of space tug systems. The most cost-effective investment and scheduling decisions for a choice of expendable and reusable high energy stages for future space activies were researched. As manager of another project, Dr. Greenblat studied the economic characteristics of advanced chemical, nuclear rocket, nuclear electric and solar electric high energy propulsion systems.

7. ECON, PROJECT MANAGEMENT & STUDY TEAM

7.1 Definition and Organization

ECON is a policy research and consulting firm organized in 1973 by senior professionals formerly associated with R[illegible] Mathematica, Inc., and Princeton University. The company's objective is to assist business and government clients in formulating workable solutions to complex management, financial, economic, and technical problems.

The company's full-time staff consists of approximately twenty full-time professionals and support personnel and a similar number of associates who are affiliated with universities and work for ECON on a part-time or consulting basis. The staff is multidisciplinary, consisting of economists, engineers, scientists, operations research analysts, computer programmers, communications specialists, mathematicians and statisticians.

The management chart, Figure 7.1 represents the company's organizational structure.

ECON's main offices are in Princeton, New Jersey. A branch office is located in San Jose, California.

7.2 ECON Project Experience

The diversity of professional skills within ECON enables the company to solve problems requiring multidiscipline analysis. ECON personnel have managed projects ranging from several thousand dollars to several million dollars in scope and are presently involved in a variety of high-visibility studies. Their work with ECON in its first year of operation includes the following completed and ongoing projects:

- determination of appropriate discount rates for evaluating future costs and benefits from investments in new technologies for a non-profit corporation,
- technology and economic assessments for NASA,
- a metropolitan transportation study for a state government,
- a course in economic analysis for top NASA management,
- studies of the economics and impact of technology on the communications industry for government and private sector clients,

- service on Congressional committees,
- preparation and presentation of Congressional testimony on space technology and energy.

ECON personnel who will work on this study have, in the past, either managed or contributed to programs closely related, in content and scope, to the needs of this program.

Experience in satellite concepts, design, operations, costs and economics has been applied to communications, meteorology, earth resources, space research, atmospheric research and a wide variety of military applications. Experience in design, operation and evaluation of TV displays has been gained through the Ranger Six camera television system which provided high resolution photographs of the moon, the Earth Resources Multispectral Camera System, employment of low light level TV in military detection and observational systems and for missile guidance.

Because of the fundamental role of data to the solution of the majority of ECON's research and consulting projects, valid methods and procedures for data definition, collection, analysis and evaluation are continually maintained and updated.

Because of the fundamental role of economics in ECON's projects ECON personnel are well versed in the current methodologies and techniques for costing, cost effectiveness and cost benefit measures and economic analysis. ECON has recently provided courses to the government on these subjects

7.3 Computer Facilities

ECON's in-house computer facilities consist of an interactive time sharing terminal connected to the Virtual Control Program/Conversational Software System (VP/CSS) of National CSS, Inc. The NCSS computer network consists of five IBM A/360 Model 67 processors which are accessible through either the interactive terminal or a standard IBM OS/360 batch system. The maximum program size in NCSS is 8.4 million bits of memory (1024K bytes).

ECON, Inc. has also contracted with the nearby Princeton University Computer Center to obtain prime time on their system. The main computers consist of an IBM S/360 Model 91, and IBM S/370 Model 155 and three IBM S/360 Model 20's. These are accessible through a modified IBM OS/360 batch system or through remote job entries (RJE's) located on the University campus. The maximum program size is similar to the NCSS computer.

7.4 Study Management

All ECON projects are assigned a project director and a project manager. The project director is ultimately responsible for the quality of the work provided to the client. He works in close cooperation with the project manager and is directly responsible to the ECON board of directors. The project manager is responsible for the day-to-day direction of the project, the assigning of project personnel, the coordination of work tasks and matters pertaining to budgeting, reporting and documentation. The project manager reports directly to a vice president concerning budgeting and manpower decisions and to the project director concerning decisions determining work quantity, scope and quality.

7.5 Study Personnel

Key senior personnel who will be assigned to work on this proposed project are:

Mr. Bernard P. Miller - Project Director
Mr. Joel S. Greenberg - Economics and Costs
Mr. Kenneth Hicks - Technical Performance

J. S. Greenberg and K. Hicks will function as project managers in their respective specialties.

Biographies of these Key personnel who will contribute to this study and ECON's management follow:

Dr. Klaus P. Heiss
Dr. Edward Greenblat
Mr. Robert J. Christie
Mr. Bernard P. Miller
Mr. Kenneth Hicks
Mr. Joel S. Greenberg
Dr. Vladimir A. Masch
Mr. John P. Skratt

Klaus P. Heiss
President
ECON, Inc.

Education:

1971	Graduate Course on Space Propulsion Systems (AMS-581) Aerospace and Mechanical Sciences, Princeton University
1964	Ph.D., Hochschule for Welthandel, Vienna, Austria, Economics
1963	University of Bocconi, Milan, Italy, Economics
1962	B.A., Hochschule for Welthandel, Vienna, Austria, Economics

Experience:

As President of ECON Inc., Dr. Heiss is directly involved with project work and administration. In two years at Princeton University his major fields of research were mathematical economics, econometrics and game theory. In addition to this, his European education provides a strong background and understanding of international finance, the role of inflation and economic policy planning at a national level. Since 1964, Dr. Heiss has worked in close cooperation with Dr. Oskar Morgenstern.

Prior to founding ECON, Dr. Heiss was associated with the consulting and research firm, Mathematica, Inc. While with Mathematica, he completed the economic evaluation of major new technological systems for various US Government agencies including the US Atomic Energy Commission, the US Department of Transportation, the Office of Naval Research the Department of Interior and the National Aeronautics and Space Administration , private industry and international organizations. Some of this work has had a major impact on actual policy decisions.

Important innovations in cost-benefit analyses resulted from the study Dr. Heiss directed for the National Aeronautics and Space Administration from June 1970 to January 1972. The General Accounting Office of the US Congress confirmed the findings of the study in April 1972. Subsequently, Dr. Heiss testified on the Space Shuttle program evaluation before the US Senate. He has given various presentations to the President's Science Advisory Committee and the National Academy of Engineering on the Space Shuttle Program.

The author of numerous publications, Dr. Heiss is also a frequent speaker at professional conferences and symposiums.